The Easy Analysis of Modern Explosives.

COMPILED FOR ENGINEERING NEWS BY GEO. J. SPECHT, C. E.

In continuation of recent publications in this journal (July 5, 1884) on high explosives, the following additional data is presented:

M. Hugo Muenet, Manager of the Arlberg Dynamite Company, at a recent meeting of the Austrian Society of Civil Engineers and Architects, gave an account of some simple analysis of high explosives, which any one can make for himself.

The simplest form of dynamite is the old *Kieselguhr* dynamite. For analysis, a quantity of from 1.5 to 2 grams (23.2 to 30.9 grains Troy) of this powder is put in a watch-glass of known weight; it is then dried in an *exsiccator* over chloride of calcium or over sulphuric acid for at least two days. Let us assume that before drying we have the following weight:

Watch-glass with powder	5.7412 grams.
" without "	3.8534 "
Dynamite	1.8878 grams.

and after drying, we have

Watch-glass with powder	5.7176 grams.
" without "	3.8534 "
Dynamite	1.8642 grams.

Deducting, we have 1.8878—1.8642 = 0.0236 grams = 1.25 per cent. moisture.

Then, two filtering papers of exactly equal size and weight being prepared, a thin beaker, 1¼ in. wide by 1½ in. high, is weighed accurately and put under a glass-funnel, the latter provided with one of the filtering papers. This paper is slightly moistened with ether, and the dynamite put into the filter is treated to a repeated sprinkling of ether, until, after this has been done six or eight times, all the nitro-glycerine will have been dissolved and filtered into the beaker. As soon as the filtering paper is, dry, it is cleaned with ether and then heated together with its contents in a platina-pan of known weight. After a uniform color has been obtained, it is allowed to cool and then weighed. As a result we have

Weight of platina-pan and contents	15.6616 grams.
" " " without "	15.1769 "
Therefore, Keiselguhr and ash	0.0011 grams.

Then the second filter-paper of exactly the same weight as the one used, is reduced to ashes in the platina-pan and again weighed.

Weight of platina-pan and contents	15.1780 grams.
" " " without "	15.1769 "
Therefore ash	0.4847 grams.

The keiselguhr equals, 0.4847—0.0011 = 0.4836 grams, equal 23.49 per cent.

The percentage of nitro-glycerine is determined as follows: A water-bath, covered with a sheet of tin and a wire-netting, is heated to about 70° Centigrade; the beaker with its filtered contents is put on the wire-netting. The ether must not boil but slowly evaporate; and as soon as it has nearly all evaporated, the flame is repeatedly withdrawn. The filtered substance will soon assume a milky appearance, and when this takes place the beaker is lifted several times and shaken a little to stir up the contents. When all the ether has evaporated the remainder consists of nitro-glycerine and acetic ether, which can be evaporated by continued heating over the water-bath. If an air-pump is at hand even the smallest traces of acetic ether can be extracted.

We have now:—

Weight of beaker with contents	42.9250 grams.
" " without "	41.5744 "
then nitro-glycerine	1.3506 grams.

or 75.26 per cent. The explosive examined is therefore composed of:—

Nitro-glycerine	75.26 per cent.
Kieselguhr	23.46 "
Moisture	1.25 "

A detailed examination of the kieselguhr must be made under a microscope (900 magnifying power) to ascertain whether it contains a heavy percentage of *Bacillaria* and *Pleurosygma* (the first named infusoria to be largely in excess,) but no grains of quartz and no wheel-shaped *Dyktiodaceas*. A good Kieselguhr is absolutely necessary for good guhr-dynamite; bad Kieselguhr, even with the same percentage of nitro-glycerine, makes a weaker dynamite.

The determination of the percentage of nitrogen in the nitro-glycerine will be mentioned later.

Explosive Gelatine. The analysis of this is as follows:— About 1.5 to 2.0 grams of gelatine is taken and weighed, assuming that we have:

Beaker with powder	42.2103 grams.
" without "	41.5306 "
Then gelatine	1.6798 grams.

A few drops of alchohol are then poured upon the gelatine, and after that, a surplus of

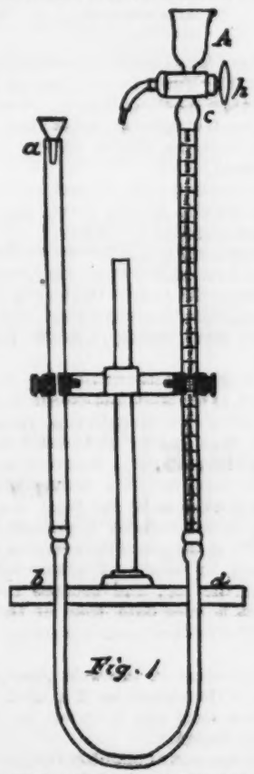


Fig. 1

THE LUNGE NITROMETER.

ether, until the nitro-glycerine and nitro-cellulose is completely disolved. Then a surplus of chloroform is added. Two filtering-papers exactly alike are cut and one of them laid in a glass funnel. The solution of chloroform, disolved nitro-glycerine and nitro-cellulose is then filtered into a beaker of known weight and frequently wetted with chloroform. The filtered substance is then chloroform and dissolved nitro-glycerine, while the remainder is nitro-cellulose.

The filtering-paper is then taken from the funnel, the chloroform, hanging about the filter, allowed to evaporate, and the funnel thoroughly cleaned with chloroform. Then the filtering-paper with the nitro-cellulose and the other filter not used are put over a water-bath for about 15 minutes with a temperature of 100° centigrade, and both filters weighed. The difference in their weights gives the proportion of nitro-cellulose; say in this case the difference is 0.1243 grams, = 7.4 per cent. nitro-cellulose.

The filtered fluid is then treated same as in first test, with the result.

Weight beaker with contents	43.0683 grams.
" " without "	41.5306 "
hence nitro-glycerine	1.5555 "

or 92.6 per cent. The explosive gelatine consequently contains 92.6 per cent. nitro-glycerine and 7.4 per cent. of nitro-cellulose. It is advisable to determine the moisture in the gelatine before its solution in ether and alcohol.

Dynamite, No. 1 New.—Weigh about 2.5 to 3 grams and dry for about 3 days in an *exsiccator*, it is then weighed again. Say the following are the results:

Watch-glass with contents	8.7939 grams.
" without "	5.3538 "
hence dynamite and moisture	2.9401 "

and after drying in the *exsiccator*, we have

Watch-glass with contents	8.7616 grams.
" without "	5.8538 "
hence dynamite	2.9078 "

2.9401—2.9078 = 0.0323 grs. = 1.10 per cent. moisture.

The dynamite in the beaker is then moistened with some alcohol, then ether is added until the nitro-glycerine and the gun-cotton are completely dissolved. It is then filtered through a filtering paper of known weight, and washed with ether. The ether and alcohol is then evaporated and the filtering paper dried at about 100° Cent. The filtered fluid is covered with chloroform which separates the nitro-glycerine from the gun-cotton. The proceeding is the same as that with explosive gelatine, described above. When the dry filtering paper is weighed we have:

Weight of filtering paper with contents	1.8358 grams.
" " " without "	0.7623 "
therefore absorbent alone	1.0735 "

or 36.51 per cent.

The paper with the absorbent is then put into the funnel and is repeatedly whetted with boiling water until all the saltpetre and soda is dissolved. The filtered fluid is now put in a platina cup and carefully dried over a water-bath, and after having been left for twenty-four hours over the *exsiccator*, it is weighed:

Platina cup with contents	15.9322 grams.
" " without "	15.1769 "
hence saltpetre and soda	0.7553 "

Besides these two substances the residue contains the dissolved parts of wood-pulp. For common practice this analysis is sufficient, and we have for the powder examined:

Moisture	0.0323	grams, or	1.10	per cent.
Saltpetre, soda and dissolved wood-pulp	0.7553	" "	25.68	"
Wood-pulp	0.3182	" "	10.82	"
Gun-cotton	0.0647	" "	2.20	"
Nitro-glycerine	1.7693	" "	60.17	"
Loss	0.0003	" "	0.03	"
	2.9401		100.00	

If an exact analysis is desired, then, after the above described proceeding, we must determine the residue in the filtering-paper:

Paper with residue	1.0805 grs.
" without "	0.7623 "
Therefore dried wood-pulp	0.3182 grs. = 10.82 per ct.

Then a few drops of water with one drop of nitric acid are added to the salts in the platina cup, and after that it is dried and weighed. From the difference the percentage of soda can be calculated as the soda has been changed by the nitric acid into nitrate of soda. For instance, first weight of saltpetre, soda and dissolved wood-pulp (as above) 0.7553 grs. = P; second weight = 0.7450 grs. = P', therefore difference = 0.0103 grs. The molecular weight of nitrate of soda is 85, twice the same = 170; molecular weight of soda = 106. We have now the proportion:

$$106 : (170-106) :: x : 0.0103 \text{ or}$$
$$106 : 64 :: x : 0.0103, \text{ hence}$$
$$x = \frac{106 \times 0.0103}{64} = 0.0171 \text{ grs. of soda.}$$

To ascertain the proportion of the dissolved wood-pulp, the contents of the platina cup are heated until the saltpetre is melted, it is then cooled, a little water and a drop of nitric acid added, and then dried over steam. The cup is then heated to 150° Cent., dried on an *exsiccator* and then weighed:—If, for instance, the weight of the cup and contents is 0.7273 grs. then P' = 0.7450, P'' = 0.7273; the difference is 0.0177 grs., equal to the weight of

the dissolved constituents of the wood-pulp. The above given weight of 0.7553 grs. is composed as follows:

Nitrate of Potassa	0.7205 gr.	=	24.50 per cent.
Soda	0.0171 "	=	0.58 "
Dissolved wood-pulp	0.0177 "	=	0.60 "
	0.7553 gr.		25.68 per cent.

These examples show that an analysis of dynamite can be made at a small expense of time and means; all that is needed is careful, intelligent work and a good scale, accurate to $\frac{1}{10000}$.

The determination of the nitrogen in nitro-glycerine is also quite easy. The nitrometer of Prof. Lunge consists of two glass tubes *a* and *c* (Fig. 1) connected by a rubber tube and held by the frame *bd*. One of the glass tubes is divided into millimetres, has a funnel A and two-way cock *h*. Both tubes are filled with mercury through the tube *a*; all air-bubbles must be carefully removed by pressing.

By setting the tube *c* low down in the frame and by opening the cock *h*, the tube will be filled completely with mercury. Then the cock is closed; over the end of the cock a short piece of rubber tube is drawn which is closed by a short glass stopper. Then about 0.12 grams of well dried nitro glycerine is mixed with 5.60 gr. concentrated sulphuric acid in a test tube. This solution is poured into the funnel A, the cock *h* is turned so that the solution runs into the tube *c*, the cock being closed when not more than one or two drops are left in the funnel. The test tube is then again filled with 5.50 gr. of concentrated sulphuric acid, so that even the least trace of nitro glycerine is dissolved; this, excepting a few drops, is also poured into the tube. Then the test tube is filled with the same amount of diluted sulphuric acid (1.83 gr. of water and 3.67 gr. sulphuric acid) and allowed to cool a little. This solution is used to clean the funnel and is also allowed to run into the tube. No air must be allowed to enter the glass tube.

We have now from 9 to 10 cubic centimetres of a solution in the graduated tube. This is raised and lowered several times, and well shaken for several minutes, during which time, however, the frame remains firmly screwed to the table. After about half an hour the temperatures are equalized and the pressure in the tubes is then regulated by proper raising and lowering of the same. The concentrated sulphuric acid, charged with sulphate of mercury has a specific gravity of $\frac{1}{13}$th of that of mercury. With the pressure equalized, the height of the column of sulphuric acid is measured with the micrometer = 39.6 cubic centimetres.

We have previously ascertained that the

Weight of vessel with nitro-glycerine	=	6.6361 grams.
" " without	=	6.5106 "
therefore nitro-glycerine	=	0.1255 "

the thermometer reads, $T = +18°$ *C*, the mercury barometer stands, *B.* st. = 740 mm. By Lunge's tables, *T* reduced to O° and *B.* st. to 760 mm, gives us 36.7 cubic centimetres. This multiplied by the weight of 1 cubic centimetre (= 0.627 milligram) gives, 36,7 + 0.627 = 23.0109 milligrams or expressed in percentage, *x* : 23,0109 :: 100 : 1255 mgr., *x* = 18.33 per cent.; which means that in the 125.5 mgr. of nitro-glycerine examined, 23,0109 mgr. or 18.33 per cent was nitrogen.

Good nitro-glycerine should be nearly equal to tri-nitro-glycerine, the chemical formula of which is:

$$\left.\begin{matrix} CH_2-O-NO_2 \\ CH-O-NO_2 \\ CH_2-O-NO_2 \end{matrix}\right\} C_3H_5N_3O_9 = 36+5+42+144 = 227 \text{ parts by weight}$$

In 227 parts there are 42 parts of nitrogen, therefore in 100 parts, 222 : 100 :: 42 ; *x*.

x = 18.5022 per cent. nitro-glycerine.

Captain Hess published in No. 7 of the transactions of the Austrian Military Committee, 1881, a series of experiments made to ascertain the percentage of nitrogen in explosives. Some of the results are given as follows:

Nitro-glycerine of Zamky 1879 N =	18.21 to 18.40 per cent.		
Gun-cotton	11.09	- -	"
English Gun-cotton from Faversham,	12.89	- -	"
Prussian " Kruppa.	12.23	- -	"
Gun-cotton from Histenberg ten years under water	11.99	- -	"
The same, re-nitrated	12.87	- -	"
Nitro-glycerine, obtained from Guhr-dynamite 1877	18.17	- -	"
Nitrated hydro-cellulose from Zamky	12.18	- -	"

This shows that the European nitro-glycerine works produce an article not much inferior to pure Tri-nitro-glycerine.

Tunnel Alignment.*

BY F. P. STEARNS, MEMBER OF THE BOSTON SOCIETY OF CIVIL ENGINEERS.

(Read May 21, 1883.)

The basis of this article is the work done at Dorchester-Bay Tunnel on the line of the new Main Drainage Works of Boston. Some problems in tunnel alignment arose there, which could not well be solved by the methods generally used.

The main portion of the tunnel was straight, 6,090 ft. in length, nearly level, and about 150 ft. below high tide in the bay.

There were three shafts known as the West, Middle and East shafts; the East and West shafts being at the ends of the length referred to, and the middle one somewhat east of the middle, or, more exactly, 3,255 ft. from the West one.

The three shafts, although of the same design, did not, as the work was executed, present equal facilities for transferring lines down them, nor were exactly the same methods used at the different ones. To avoid repetition and length, however, this article will refer only to the work done at the West shaft, this shaft being chosen because it presented peculiar difficulty in the use of the common method of alignment by means of plumb-bobs suspended from the top, and because the work was done at a later date than at the other shafts and the method used was more nearly perfected.

A vertical section of the west shaft, on the center line of the tunnel, as it existed at the time the lines were run, is shown on the accompanying diagram.

The shaft was out of plumb in the line of the tunnel 2.66 ft. in its depth of about 160 ft. The upper half was formed by sinking an iron cylinder having an internal diameter of 9 ft. 6 in., which was diminished at the flanges where the different sections were bolted together to a clear opening of 8 ft. 10 in. Below the cylinder the shaft was sunk for the greater part of the way through clay and was lined with timber. Below the timbering the shaft was in rock.† At the date represented by the diagram the shaft had been lined with brick-work, having an internal diameter of 7½ ft., from its bottom to a point about 5 ft. above the bottom of the cylinder. The shaft contained six lines of steam, water and exhaust pipes, and the guides for the "cage." None of these came on the center line. The lines B *C* and *D E* represent plumb lines from the top to the bottom of the shaft, placed as far apart as possible. The distance between them was 5.7 ft. This would have furnished a very short base from which to extend a long tunnel line, but the shortness of the base was not the greatest difficulty. In shafts of the depth of this one, where water is dripping and where currents of air are produced by hot steam-pipes and by occasional leakages of steam from them, it is necessary to protect the plumb lines by some kind of tubes; but any permanent tubes for this purpose would have been out of question in this shaft, as they would have directly in the path of the cage on which all material was transported.

In view of the difficulty of using plumb-bobs Mr. G. H. Crafts, the assistant-engineer then in charge, concluded that much more satisfactory results would be obtained by sighting down the shaft with a transit; and he proceeded to design the necessary instruments and to have them constructed.

INSTRUMENTS AND METHODS.—The top instrument was a large "straight-line" transit having a telescope magnifying forty diameters, with an object glass 2 in. in diameter. The standard which supported the telescope was U-shaped in plan, the wyes being near the ends of the U, so that the telescope could be used to sight vertically downward, as well as horiztontally.

This standard was supported by three levelling screws, which rested upon the U-shaped top of a casting. The casting was about 2ft. 6 in. high, and was made to be bolted to the top flange of the cylinder. A striking-level was used to determine when the axis of the telescope was horizontal.

The position of this instrument at the top of the West shaft is shown at A on the diagram, and the lines of sight down the shaft by the lines *A C* and *A F*. The distance between the lines at the bottom of the shaft was 7.5 feet.

At the bottom of the shaft a string was stretched along the centre line of the tunnel from the west side of the shaft to a point about 100 feet into the tunnel. The end at the shaft was fastened to the zero notch of a vernier sliding on a brass scale graduated to hundredths of a foot and reading by the vernier to thousandths. Ninety-three feet from this scale and nearly level with it a bolt was set in the side of the tunnel from which offsets were taken to the string. These offsets were taken with a brass rod fixed horizontally, perpendicular to the line of the tunnel, and graduated in the same manner as the scale. The string was so fastened in the tunnel that, where it passed the rod, it just touched its upper surface.

To furnish the necessary illumination at the bottom of the shaft a large lantern with a 12-inch reflector was used. This lantern threw its rays horizontally, and a mirror set at an angle of 45 degrees deflected them up the shaft, thus furnishing a brilliant spot at the bottom of the shaft on which were seen as black lines both the string and the cross-wires. As the use of a vertical cross-wire would not have admitted of accurate sights, and would have caused confusion on account of its looking so much like the string, two wires crossing each other and making a small angle with the vertical was used instead.

After setting the telescope on the tunnel line above ground it was revolved and pointed at the string close by the scale, and this part of the string was set on line in accordance with orders received by telephone from above. It is, perhaps, needless to add that the end of the string in the tunnel was held "on line" during this operation as nearly as the existing knowledge permitted. The telescope was next directed to the string at the opposite side of the shaft, and that part was put on line by moving the string at the offset rod in the tunnel. These operations were repeated many times in a day, and each trial gave a line in the tunnel fixed by two points at a considerable distance from each other.

The only important error which was feared was that which might be due to refraction in the shaft, caused by the warmth of steam-pipes on one side. Such a cause of error would not affect the results by the whole amount of the refraction, but rather by the difference in the refraction of the two lines of sight down the shaft.

At the West shaft the line was transferred

*From the *Journal of the Association of Engineering Societies* July, 1884.

†A description of difficulties encountered while sinking this shaft is given in Shaft Sinking under Difficulties at Dorchester-Bay Tunnel. by D. McN. Stauffer. Trans Am. Soc. of Civil Engineers: October, 1881.

into the tunnel on three different days with the following results, as compared with the line found to be the true one after the completion of the excavation:

Date	Variations from true line per 100 feet.	Variations from true line in width of shaft.
May 22, 1881	0.0085 ft. north	0.0006 ft. north
June 5, "	0.0193 " "	0.0014 " "
July 10, "	0.0044 " "	0.0003 " "
Average	0.0107 ft. north	0.0008 ft. north

From this table it will be seen that the line run down the shaft diverged to the *north* of the true line in every case, the *average* variation from the true line being as great as the *maximum* difference between observations.

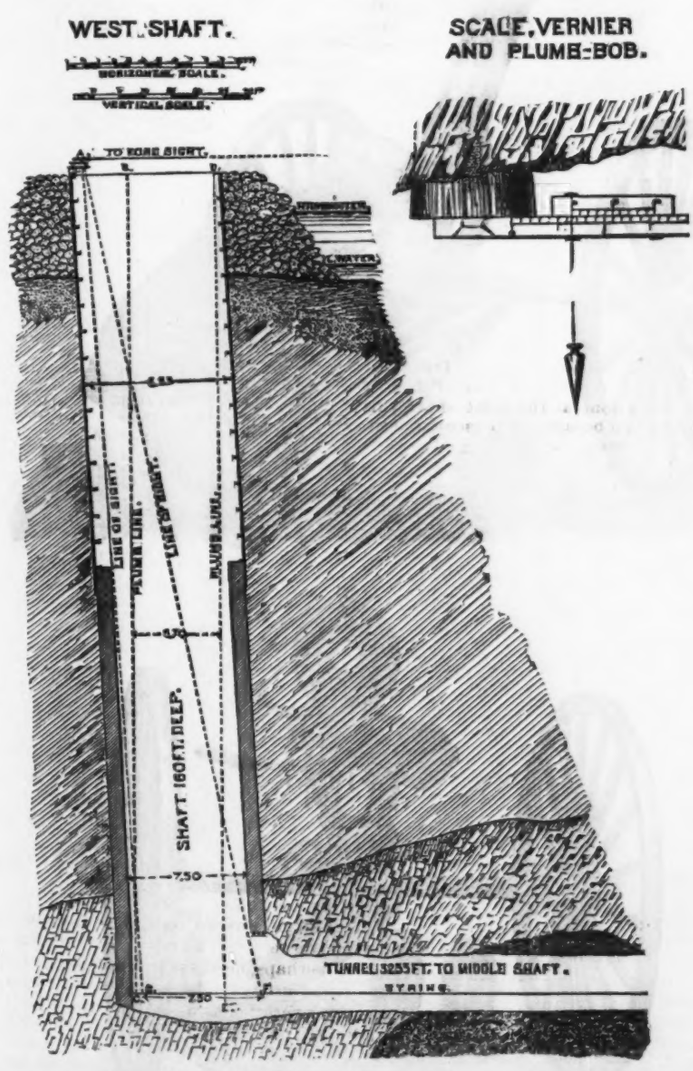
On the first day the line of sight which crossed the shaft on its way down passed, near the bottom of the shaft, quite close to a steam pipe. Arrangements were made to have this pipe removed to a greater distance before a second attempt to run the line was made; but when the party arrived on the ground its position had not been changed, though some other changes had been made which improved the conditions a little. On the third date the pipes had been placed in a more favorable position.

Neither of the lines run varied from the true line enough to have caused an error of practical importance at the headings.

With regard to the merits of this method it may be said, that by each set of sights a line above ground, fixed by two points a long distance apart, is transferred in a very direct manner into the tunnel and fixed there by points so far apart that its prolongation will not require more than ordinary care. To accomplish the same result with plumb-bobs several distinct operations would be required.

The working base at the foot of the shaft can be materially increased, when the new method is used, by an enlargement of the shaft near its bottom; while to obtain the same result with plumb-bobs the enlargement would have to extend the whole length.

DIAGRAM ILLUSTRATING ALIGNMENT OF DORCHESTER BAY TUNNEL, BOSTON, MASS.



While considering the causes of error in the new method but two were thought of which might have a tendency to vary from the truth more in one direction than the other. These were:

(*a*) Refraction of the line of sight in the shaft.

(*b*) The bearings of the axis of the telescope not being truly cylindrical.

If there were no hot pipes in a shaft there would probably be no error from refraction; and even if there are such pipes their effect would be neutralized to a large extent by placing them symmetrically on opposite sides of the shaft—a thing which was not done at the Dorchester-Bay Tunnel.

If the bearings of the telescope axis are not cylindrical but somewhat irregular in form, the line of sight will not travel in an exact plane when the telescope is revolved. By repeating the operation with the telescope reversed in the wyes the same deviations from the true plane occur, only they do not happen in the same parts of the plane. It follows, therefore, that on any given line of sight, except a vertical, the average of direct and reversed sights may vary from the truth constantly in one direction if the bearings of the axis are at all irregular in form.

As a precaution against errors of this kind it would be well to avoid the use of a transit with a much worn axis, and to use only an instrument which a good maker would guarantee to have truly cylindrical bearings.

In all other respects, except as above stated, an average of direct and reversed sights will be as liable to vary one way as the other.

Although the term "new" has been applied to the method of tunnel alignment described in this paper, the idea of sighting down a shaft is probably by no means new; yet, at the time this method was adopted and used at this tunnel, the engineers connected with the work knew nothing of its practical application elsewhere. It appears, however, that it was adopted in the Severn Tunnel as early as 1875, five years before it was adopted here.

A description of the alignment of that tunnel is given in *Engineering* of Jan. 20th, 1882, and the method even in details was almost identical with that employed here. At that tunnel the line was run down a shaft 200 ft. deep and about 12 ft. in diameter. By the method employed a base of 14 ft. was obtained at the bottom of the shaft, from which the line was extended two miles. At the headings the lines met almost exactly.

PRODUCING LINES IN THE TUNNEL.

During the earlier stages of the work a transit was used for producing lines, but as the headings advanced the ventilation became worse, so that it was difficult to see even 125 ft. on account of smoke and steam, and at times a light distant 75 or 100 ft. was invisible. At one time, after wasting two or three days in ineffectual attempts to produce a line fixed by points only 125 ft. apart, the use of a string in this tunnel was resorted to for the first time. Although a common twine was used on this occasion the result was so successful that all further use of a transit in the tunnel was abandoned.

In describing the method finally adopted for producing lines with a string it will be premised that the line to be produced is already fixed upon two scales in the roof of the tunnel, about 300 ft. apart, and that another scale has been put in the roof 300 ft. further into the tunnel. The first proceeding was to set two posts of 2 × 3 in. joist vertically in the center line so far apart as to include the three scales between them. These posts were wedged firmly between the top and bottom of the tunnel. A coarse linen thread or fine netting twine* was stretched between these posts as tightly as its strength would allow, leaving a sag in the middle of about 3 or 4 ft.

The reading on the three scales vertically over the string was next taken, the plumbing being done with a plumb-bob, about an inch long, suspended by a thread from the notch of a vernier sliding on the scale. This apparatus is shown to one-half of the natural scale on the diagramon.

When doing *accurate* work no attempt was

*The ultimate strength of the line was reached when, in a length of 800 ft. the sag was reduced below about 6 ft. It was found to be stronger in proportion to its weight than oiled silk or grass-line; with the further advantage that it cost so little (50 cents for a ball containing about 2,000 ft.) that .. could be renewed very frequently at a trifling expense. It is quite possible that shoe thread or some other linen line might give even better results.

made to set the string exactly on the center-line, but rather to put it in a fixed position near the center. From the scale-readings obtained with the string in this position, the true center line was found by a very simple calculation.

A check line was run by moving the string a little to one side and taking another set of readings. The production of the line by the two trials seldom varied more than one thousanth of a foot. A very good test of accuracy of this method was made after the tunnelling was completed. The three shafts of the tunnel are in a straight line which was accurately run on top and then transferred to the bottom of each shaft with but little error, giving three points below in the straight line. On one favorable occasion a sight was obtained in the tunnel with a transit from the Middle to the East shaft. The accurate center line thus obtained was run upon the scales in the vicinity of the Middle shaft, and from there it was extended to the West shaft by the string method. Upon reaching the shaft this line varied from that obtained by plumbing from the top only one one-hundredth of a foot.

So close an agreement in the result may be in part accidental, yet there was no doubt left in the minds of those connected with the work that much more accurate results could be obtained with a string than with a transit in the smoky atmosphere of a tunnel.

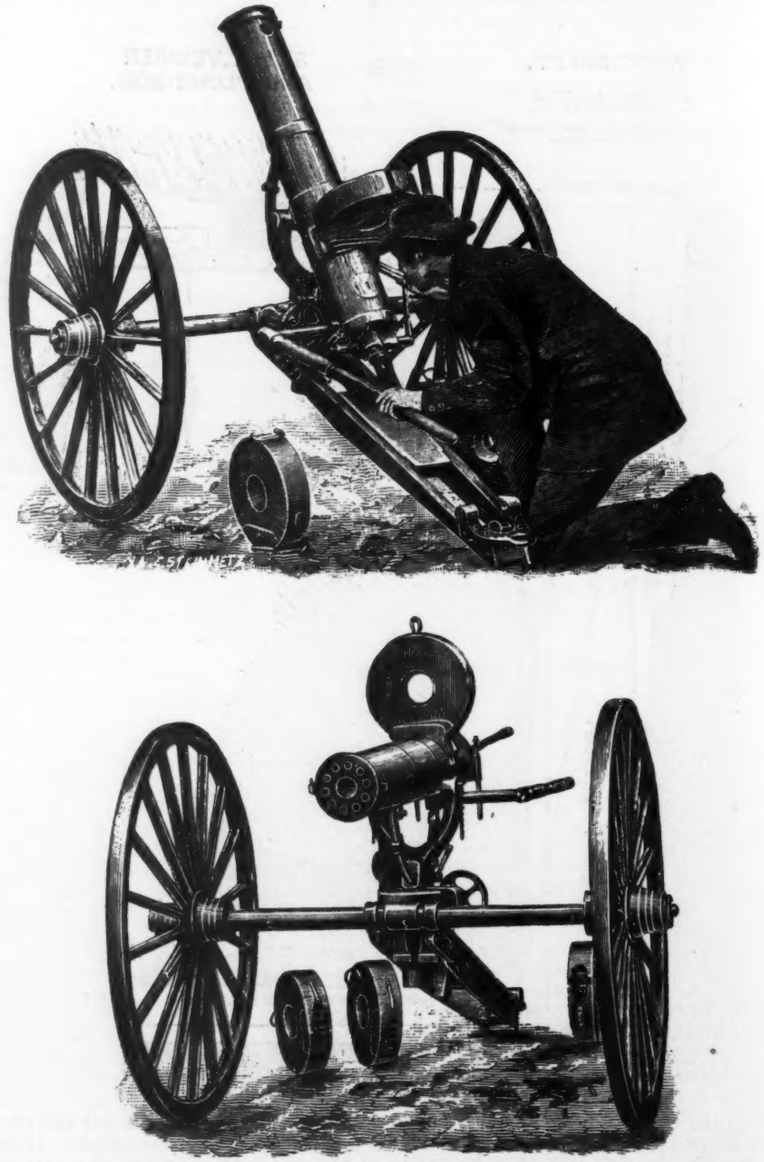
Engineers as Contractor's Agents.

The risk that is incurred by architects and engineers in dealing with sub-contractors, was exemplified by a case which was heard lately at the Suffolk Assizes. The circumstances were as follows:—A contract had been entered into by Messrs. Pearson in 1879 for the construction of the Ipswich Sewerage Works, but it did not include penstocks and other ironwork. Afterwards Mr. Bruff, the engineer, agreed that the contractors were to supply the ironwork. They naturally wished to obtain the articles from the stock of some London house. The engineer recommended that the order should be given instead to a local ironworks owned by Mr. Mumford. There was, however, no evidence of any order in writing from Messrs. Pearson. The prices were settled by Mr. Bruff, and the invoices for the ironwork supplied from time to time were made out in his name. Mr. Bruff said that he included the amounts for the ironwork in Messrs Pearson's certificates; but, on the other hand, one of the contractors said that the ironwork was not included in their monthly accounts, and they had nothing to do with the ordering of it. The balance unpaid amounted to 447*l*. The case was heard before Mr. Justice Denman alone, and under the circumstances it is not surprising that his lordship wished for the assistance of a jury. The judge was of opinion that Mr. Bruff acted as the agent of the contractors, a position which was not to be desired or encouraged. If the invoices were interpreted literally, then Mr. Bruff was the debtor. Accordingly, after pointing out the unwisdom of the arrangements, judgment was given for the sum claimed. It may be assumed that if the action had been taken against the engineer, judgment must have gone against him.—London *Architect*.

THE Berlin Iron Bridge Co., in East Berlin, Conn., is building a highway bridge of 280 feet span to go to Williamsport, Pa., one of 160 feet span for Camden, Me., a 140-foot span for Cameron, N. Y., and a number of smaller bridges. The company has recently taken a contract for a new iron drawbridge over the Housatonic River at Bridgeport, Conn., for the New York, New Haven & Hartford road. The Atlanta Bridge Works of Wilkins, Post & Co., Atlanta, Ga., have recently completed two spans of 130 feet each in the bridge over the James River in Richmond, Va., for the Richmond & Danville road.

The Gatling Gun.

THE following description of the Gatling gun is from the latest authority and presents it in its present approved form. These weapons have six, eight, and ten barrels, each being provided with its corresponding lock. The barrels and locks revolve together inside an outer stationary case, but in addition to this the locks have an independent forward and backward motion. The former places the cartridges in the chambers of the barrels and closes the breech at each discharge, while the latter extracts the empty cartridge case after firing. The cartridges are supplied to the gun from magazines consisting of a circular drum of a width slightly greater than the length of the cartridge. On the two circular plates which form the ends of the drum, are spiral grooves running from the center to the outer edge by which the ends of the cartridges are supported and guided in and out of the magazine, Fig. 7. In the center of the magazine between these grooved plates, are two other circular plates which revolve round the center shaft; they have a number of slots radiating from the center and are connected near the outer edge by pins (Fig. 8). These two plates when caused to revolve, force the cartridges along the grooves in the end plates out of the magazine into the receiver of the gun and in front of the locks. The center plates of the magazine are revolved by projections on the receiver, which engage with the pins that connect the center plates, in the form of gear. The magazine is held in its place over the receiver by flanges on each disc of the hopper, with two undercut slots in which two projections on the magazine fit, so as to lock it in its place. The slots are of unequal size, so that the magazine cannot be wrongly inserted. On the left-hand side of the hopper are two wedge-shaped points that are let down into the receiver and eject the empty shell from the receiver when it has been extracted from the chambers by the backward motion of the lock. The extractor is so formed that its hook remains always in front of the cartridge head, and is rendered stronger by being made double its former width circumferentially. It has no spring and does not lift the lock by springing over the cartridge head. The cartridge is therefore always struck centrally, instead of on the side. The extractor is so arranged that after each discharge it holds back the firing pin so that its point does not project in front of the lock face until released by the cocking ring, making it impossible for a premature explosion of the cartridge to take place by the lock during its foward motion coming in contact with the cartridge heads. In firing at high elevations the cartridges are



GATLING GUN—Front and Rear Views.

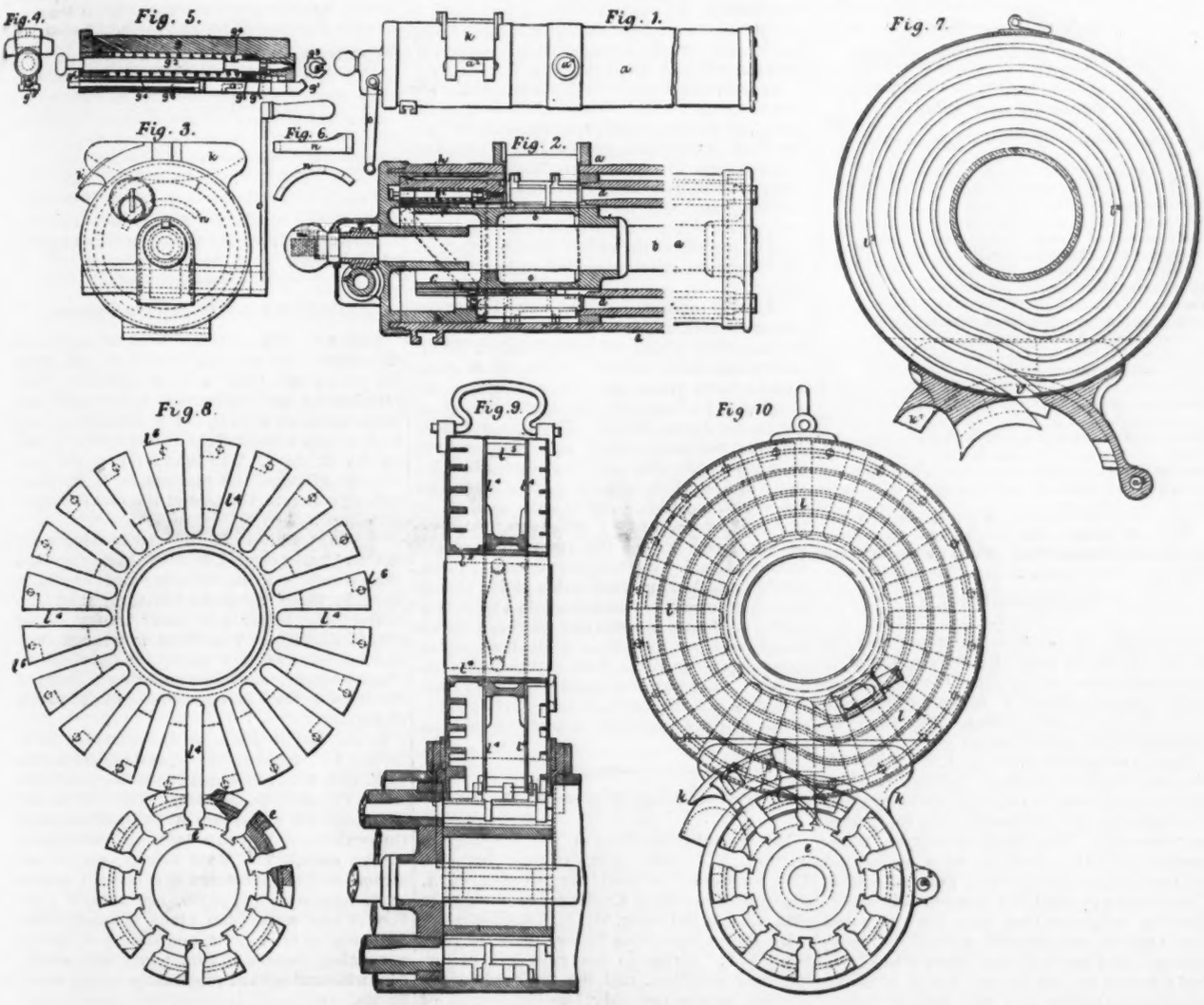
prevented from sliding back into to the mechanism through the orifice in the front lock flange, either when the locks are in or out of the gun, by the openings being flanged and the lock being made to correspond. The gun has been fired in a vertical position with as much ease and certainty as when horizontal. The rear portion of the lock is supported by a T-way at the center, instead of the bottom, in order to prevent all possibility of jamming by dust or sand. The gun is mounted on trunnions 2 in. below the center, and is elevated and depressed by means of a circular elevating arc connected at both extremities with the gun, and actuated by gearing so arranged that elevation and depression are indicated in degrees and minutes. A horizontal limb for direction is graduated in the same way. Both kinds of gear are so arranged that they can be instantly thrown out to allow the gun to be moved rapidly in all directions by means of a long handspike. The automatic oscillator is dispensed with, the effect being produced by hand movement of the handspike. An adjustment of the lateral training is obtained by means of stops on the turn-table of the carriage, which can be set to any required number of degrees. The adjustment of the vertical oscillation is obtained by means of stops in the elevating arc, which can be set to any number of degrees. The gun can be elevated to 74 degees and depressed to 78 degrees. It is provided with two sights, one on each side. A device is added to serve the purpose of throwing the cocking ring out of action at will, and to prevent the cocking of the firing pins. This is of advantage during drill, and allows firing motion to take place without snapping, and thereby injuring the firing pins. The barrels are locked into the rear flange plate instead of being screwed as heretofore. In case of accident to any lock or barrel, the lock can be instantly removed and the firing continued with the remaining locks.

The gun can be fired with the crank either at the rear or side. When at the side, the gun fires at each turn of the crank, about one-half the number of shots to the number of barrels in the gun; when at the rear it fires at each turn of the crank, as many shots as there are barrels in the gun. The feed magazines hold from 65 to 104 cartridges each, and weigh from 10 lb. to 24½ lb. when full of cartridges. The musket-calibre guns weigh from 100 lb. to 237 lb. each, according to the number and length of the barrels.

From the foregoing general description, the illustrations will be readily understood. Fig. 1 is a side elevation of the gun, Fig. 2 is a longitudinal section through the axis, Fig. 3 an end view, and Figs. 4, 5, and 6 details of the bolts and extractors. The outer case *a* includes the group of barrels *d* which are spaced around the central axis *b*. At the rear a worm b^1 is fixed on it. This is rotated by means of the wormwheel c^1, which is operated by a crank-handle shown in the general view. The receiver for the cartridge is shown at *c*, and *f* is a chamber in one piece with it, into which the sliding bolts *g g* are drawn back. These bolts are actuated by cams formed on the ring *h* placed within the casing *a*. This ring is stationary, but the barrels *d*, the receiver *c*, and the cylinders *f* are carried round together by the crank. The magazine is placed on the casing over the opening in the receiver, being held in place by a spring catch k^1. Figs. 7, 8, 9, and 10 are views of the magazine in place and its relative position to the receiver and mechanism of the gun. The cartridges descend from the magazine and hopper into the receiver, and the projections e^1 upon this latter serve to give motion to the propeller of the feeder; the motion of the cartridge till it reaches its proper compartment is controlled by inclines, corresponding with the channels in which the cartridges are guided within the feeder. The spiral ribs on the faces of the feeding drums are shown at l^2, and l^4 are radial slots formed in the side plates of the propeller; in these the bodies of the cartridges lie. The teeth l^5 on the propeller, gear into the projection e^1 of the receiver, the result being that the catridges are brought foward at the proper moment. The magazine is charged from an opening in the side, as shown.

Experiment has demonstrated that the improved feed has not only greatly increased the direct fire, but is of value in enabling the gun to deliver high angle or mortar fire, so as to drop the balls on men behind entrenched positions at distances of from 200 to 3500 yards.

Experiments with the gun have proved that bullets so discharged come down nearly perpendicularly, and with force sufficient to penetrate from 2 in. to 5 in. of timber. With this new feed there is no chance of the cartridge jamming, even when the gun is used by inexperienced men. The perspective views give a good idea of the gun and its mode of working, and the upper one illustrates the elevation at which it can be fired.



GATLING GUN—DETAILS.

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The Panama Canal.

The plain and sensible statement made in the annual report upon the Panama Canal, in our present issue, seems to be answer sufficient to the many unfriendly rumors concerning this work, now floating through the American press and telegraphed abroad.

It is the fashion to deride de Lesseps and his engineers and to prophecy failure in their efforts; to discount in fact both the energy and determination and the resources of the nation they represent. The "Monroe doctrine" is frequently referred to, as if we as a nation had any business to interfere with another coterie of free States in making a commercial concession to a company that may have any and every nation represented among its stockholders, How much of this outcry arises from rival schemes we can not say, but it is unlike Americans to attack men who have certainly accomplished wonders in the energy displayed, careful provision for the future and practical work done. Had the actors on the Isthmus been Americans, these same journals would probably have failed to find words adequate to express their admiration, that is provided the other scheme did not possess superior material attractions.

The battle-cry of the opposing forces is, that after all these years spent upon the Isthmus "only one-thirteenth of the excavation is done." They give little or no credit for the preliminary work, and spread abroad terrifying yarns as to the mortality among the workmen. Basing their estimates upon the cubic yards now dug from the Canal they regard the completion of this work as impossible.

Impossible is a strange word for an American to use, after what has been accomplished upon American soil within the last decade, and de Lesseps himself points out the fallacy of measuring the work yet to be done upon the Canal by that already executed. We should give credit for, rather than censure, the wise precaution which is laying broad and well the foundation for future success. The years since 1881 have not been wasted; dry ground has been made, towns have been built for the thousands to be employed, hospitals provided for the sick and an immense fund of material gathered for the work that is to come.

The progress to this date cannot be measured in cubic yards; the present output is merely an incidental feature in the transformation of an inhospitable soil, barren of all resources, into a world's workshop fitted with the tools and labor necessary to execute one of the grandest engineering and commercial enterprises of the century, The actual work is yet to be done; what has been done is only to insure the speedy, economical and more perfect execution of the task on hand.

As an evidence of the folly of discounting the future by past work, we have the work of the first four months of this year equalling in cube the total quantity extracted to Jan. 1, 1884. It is time enough to charge the Canal Company with incapacity after we see them fail with all the necessary tools in their hands; until then every unprejudiced American should be content to wait and help rather than to obstruct the progress of our generous ally of other times.

The only satisfaction to be derived from the present attack upon the Panama Canal, is that it is an evil to which all great modern enterprises have been exposed. It was so at Suez, and for three years after its completion the English did not avail themselves of that short cut to their own Indias. The Union Pacific Railway, the bridges at St. Louis and over the East River, the Ead's jetties were all cried down at first, their promoters voted fools and the work impossible. But as each and all of these are now accomplished and accepted facts, so we expect to see the completion of the Panama Canal. Whether it is opened on Jan. 1, 1888, or within any reasonable period of that time is practically of no account in a work that is to serve future generations, perhaps better than it will our own from a dividend-paying stand-point. But even here estimates are uncertain. Suez was less promising when completed, but it has proved sufficiently good to tempt the investment of millions in Panama shares.

The Sewerage of Newark, N. J.

The Special Committee on the Sewerage of Newark, N. J., made a report upon August 1. The committee secured the services of A. Fteley as Consulting Engineer, to co-operate with the City Surveyor, Mr. J. S. Schaeffer.

Mr. Fteley reports as follows upon the plan submitted: Owing to the vast area of surrounding meadows, and the flat gradients in existing sewers the only feasible system of disposing of the sewage is by intercepting sewers and pumpage. For obvious reasons chemical treatment cannot be entertained and the plan proposes to convey the sewage to a distant point of the Bay at the southern extremity of the city territory.

The intercepting or collecting sewers will only accommodate the sewage proper and a small proportion of the rain water—amounting to $\frac{3}{4}$ inch of rainfall in 24 hours for the sewers which drain on the meadows and $\frac{1}{2}$ inch for the others; all the surplus is to be discharged as at present or through special channels to be built. This intercepting sewer will range in diameter from 3 ft. to 6½ ft. at the pumping station. At this last point will be a sewer of deposit, in duplicate, made by enlarging the collecting sewer.

The time allowed has not permitted a detailed study of the pumping plant, but as the work to be done is a maximum lift of 18 ft. from bottom of sewer, Mr. Fteley is of the opinion that the choice lies between rotary pumps and bailing wheels. From the pumping station the sewage is conveyed by a wooden sewer, placed below the water level, and, to be satisfactory, extended to the deep channel, about 3,000 ft. from the Newark shore, and constructed to admit of extension.

The plan submitted includes the drainage of the entire area of city now built up, when the city outgrows the limits these system can be continued in a similar manner, the three ultimate sub-systems uniting at a common pumping station.

To perfect the system of relief proposed, the present street sewers must be properly connected, as they are built, with the collecting sewers, and the grading of the streets must be done in such a manner as to accommodate the sewerage system.

The estimated cost of the work is as follows:

Collecting sewer, connections, gate, etc...	$190,000 00
Lifting plant and buildings	75,000 00
Outlet channel	80,000 00
	$345,000 00
Engineering and contingencies 10 per cent.	34,500 00
	$379,500 00

Mr. Fteley has been retained as Consulting Engineer, and the committee urge the adoption of his report.

The New Rush St. Bridge, Chicago.

This new swing-bridge is a wrought-iron structure of 240 ft. span and 59 ft. wide, resting upon a turn-table 48 ft. in diameter. The foundations are supported upon white oak piles, sawed off at 15 ft. below water level, and built within a water-tight caisson with an oak floor 2 ft. thick. The foundation of the pier and the filling of the pier proper is Portland cement concrete, the face of the pier is dimension stone.

The turn-table is of the rim-bearing type, the load being carried on the 74 cast-iron cone-shaped rollers 18 in. diameter and 8-in. face, kept in place by arms radiating from the center; the upper and lower tracks are of planed cast-iron. The drum is wrought-iron and carries upon it 6 heavy wrought-iron T-shaped beams, one beam under each chord of the truss in such manner as to form 18 points of support.

In the bridge there are three trusses, 21 ft. from *c.* to *c.* forming two roadways for teams 18 ft. wide between wheel guards and two side walks 7 ft. wide in the clear. The trusses are 30 ft. high for a distance of 45½ ft. in length in the center over the turn-table and 20 ft. high at the ends. The floor beams are rivited girders and the stringers are rolled I beams 10 in. deep, weighing 38 lbs. per lineal ft.; the floor is 4 in. white pine plank secured to the stringers by hook-bolts, and on top of this is a wearing surface of 3 in. white oak plank, 4 in. wide and spiked diagonally to the lower floor.

The sidewalk is covered with surfaced white oak 8 in. wide. The engine for operating the draw has two steam-cylinders 8 in. by 12 in. stroke, and the power is transmitted by friction clutches through gearing and shafting to the pinion and rack on center pier. The engine-house is above the road-way over the pivot.

Six Electric lights of 2,000 candle power each light up the bridge, the dynamo being run by an independent engine 7 in. by 9 in. stroke.

The bridge is proportioned to safely carry 5,000 lbs. per lineal foot of truss, or a total load of over 1,000 tons, and a concentrated load of 20 tons on one wagon. The superstructure of the bridge is wrought-iron solely.

The foundations and piers and pier-protection were built by Fitz-Simons & Connell, of Chicago; exclusive of temporary work and caisson, there was used in this work, 629 white oak piles, 10,300 cu. ft. of oak timber, 2,007 cu. yds. of concrete, 277 cu. yds. of stone-facing, and 534 cu. yds. of rubble masonry; 1,700 barrels of Portland cement were used in the concrete.

The superstructure was built by Rush & Coolidge, of Chicago, who used over 481 tons of iron and 7,040 cu. ft., of wood or 176 tons, making a total weight of 657 tons. This was subdivided as follows:—

Iron in turn-table	187,000 lbs.
Iron in trusses and bracing	510,000 "
Iron in floor-systems	245,000 "
Iron in end abutments	20,000 "
Wood in floors, etc	352,000 "
	1,314,000 "

The work was done under the direction and from the designs of Saml. G. Artingstall, City Engineer, and his assistants. The cost of the structure is not given.

A New Rail for Tramways.

Since January, 1884, Brussels has been experimenting with a new form of rail for its tramways which presents several advantages over the system formerly in use.

This new rail, invented by the Engineer Michelet, is made in two pieces—the rail proper and the base-rail, one fitting into the other, and united by rivets, forming a kind of riveted girder of great strength.

The rails are laid directly upon the ground and are tied, at intervals of about 10 ft., by a cross-tie of plate-iron with angles at the two ends.

The rails are jointed by allowing the joint of the rail proper to pass about 24 in. beyond the joint of the base-rail; four bolts secure the joint. This rail system is very rigid and smooth, there being no shock whatever at the joint. It is easily and rapidly laid, and costs but a little more than the old rail.

Disinfecting the Thames.

The London *Contractor* says that, according to statements made, 22 tons of chloride of lime are daily used in disinfecting the water of the Thames. At £9 per ton this amounts to about £200 per day or, for half the year, at £35,000. The *Contractor* deems this a waste of public money or that it would be better to use the principal which this annual outlay represents in setting about the removal of the danger. The Board intend to use permanganate of potash instead of the lime as a better oxidant, though more expensive, while this may mitigate the nuisance, it does not overcome the danger to health. The only real way of accomplishing the desired end is to prevent the sewage reaching the Thames at all, at any cost.

PERSONAL.

CHARLES WANBY, a distinguished European engineer, is dead.

HUGH J. JEWETT is desirous of resigning from his position as President of the Erie Railway. His contract to serve as President for ten years expired June 14. A committee has been appointed to consider his letter of resignation.

MR. F. L. HILLS, of Boston, for the past four years engineer in charge of the maintenance of way of the New York & New England Railroad, has been appointed Chief Engineer of the Wilmington & Northern Railroad, vice Mr. J. H. Thompson, resigned.

PROF. BENJAMIN S. H. MAILLEFERT died at Thomasville, N. C., Aug. 8, in the seventy-first year of his age. He formerly lived in this city, and he was a member of the firm of B. Maillefert & Co., who obtained a reputation in their experiments with surface blasting, which was applied by them to the Hell Gate work. He was engaged in this work as far back as 1855. Their implements for surface blasting consisted simply of a boat and iron rod, to feel the bottom with and to let down charges with an electric battery. The firm obtained a contract to clear away Pot Rock and Sheldrake Reef, the contract ending on Jan. 1, 1870. The result of their labor was not entirely satisfactory, as during the summer the rock was blown away only so as to give a depth of from 12 to 20 ft., while the contract called for 25 ft. The Government then took charge of the work under Gen. Newton. PROF. MAILLEFERT has since then led a quiet life, not engaging in any business.

Annual Report upon the Panama Canal.

We make the following extracts from the last annual report of Ferdinand de Lesseps and the Council of Administration upon the Panama Canal, delivered July 23, 1884:

Commencing with the financial situation of the Company the following statement is made:

All expenditure for work proper upon the Canal to June 30, 1883	108,418,097	Fr.
Machinery and real estate, the purchase 68,534 shares of the Panama R. R. and incidental expenses	120,291,228	
Total ($45,741,855)	228,709,325	
Deducting from this unpaid debts and re-discounts, etc	17,679,548	
Total net expenses to June 30, 1883, ($42,205,955)	211,029,777	
As against this outlay there is the product of 250,000 shares at 5 per cent., issued in Sept. 1882, and other incomes amounting to	416,655,760	Fr.
Deducting the expenditures	211,029,777	
Amount disposible on June 30, 1883, ($41,125,196)	205,725,982	Fr.
This last sum can be subdivided into assessments on shares, not called	147,500,000	Fr.
Capital in Treasury	58,125,982	
Total as above	205,625,982	Fr.

Since then, in the midst of trying financial times, there has been issued with complete success 600,000 bonds of 500f each, at 3% payable in installments, of which the last two mature in August and October of this year. Of the 300,000,000 of francs last authorized, there is a reserve in bonds of 129,000,000 francs.

The Panama R. R. has been put in thorough repair, new depots and shops built and rolling stock added. Instead of eight trains daily, as in 1882, twenty-two trains now pass over the line. The dividend on the stock, which was 12½ per cent. in 1882, was 15 per cent. in 1883, and will probably reach 16 to 17 per cent. in 1884. The company own 68,334 shares out of the total of 70,000 shares.

The sanitary condition of the workmen upon the Isthmus being of vital importance, the administration, with the experience at Suez to guide them, have made the organization of the medical service most thorough and complete. The report presents, without comment, the official monthly statement, from June, 1883 to May, 1884, of the total number of men employed each month and the total deaths, including those from accidents. Without giving this in detail it will suffice to say that with from 7,000 to 10,000 men at work the average mortality was about 3 per 1,000 to September, 1883, with from 11,000 to 16,000 men it was about 5½ per 1,000, until April, 1884; for the last two months with from 18,000 to 19,000 men employed it was again about 3 per 1,000.

Nothing has been spared in caring for the health of the workmen, and during 1882-83 the cost per patient per day was 6 fr. 26, at Panama, and 8 fr. 98, at Colon. During 1883-84 this expense was reduced to 5 fr. 72, at Panama, and 7 fr. 52, at Colon.

In speaking of the works themselves M. de Lesseps repeats the official programme of procedure settled upon by M. Dingler and approved by the consulting commission of engineers, as follows:—

1. Construction of the canal with a normal depth of 9 metres (29.52 ft.) below the mean sea level.

2. Width of the bottom of the canal 22 metres (72.16 ft.)

3. A direct cut from sea to sea, open to the heaven throughout its length.

4. A lock with tidal gates at Panama, to assure communication with the Pacific at any hour and under any condition of tides and temporary currents.

5. The creation of immense harbors at Colon and Panama.

6. The excavation of a grand side basin, 5 kilometres (3.1 miles) long about the central point of the canal, near Tabernilla, to permit the passing of ships.

7. The dam of Gamboa for the regulating of the flood waters of the Chagres, with diverting channels for that stream.

This programme means a total cube of earth-work of 143,880,000 cu. yds. for the digging of the canal proper and the enlargement of the ports at the end sufficiently for traffic.

The work of changing the course of the Chagres is equivalent to a total of 13,080,000 cu. yds. In the orginal estimate the digging of the canal was put down at 98,100,000 cu. yds. with the expectation that this could be reduced to 95,466,688 cu. yds. But as work has progressed we find in one portion a less quantity of hard rock than estimated, on the other hand a greater quantity of earth capable of being moved by cheaper processes; the economy in time resulting from this improved condition will in some degree compensate for the extra amount to be moved.

The report then gives in detail the condition of affairs at each working point, but in a manner too extended for this abstract.

That now the work being under full headway it is well to think that the principal effort to be made in such matters is the installation and creation of machinery. When once under way it will gradually improve in efficiency.

The present condition of the cubes excavated may be stated as follows:

Work done previous to Jan. 1, 1884	3,610,778 cu. yds.
Work done in the first four month of 1884	3,217,460 cu. yds.
Total work done to May 1, 1884	6,858,239 cu. yds.

It will be remarked that the actual cube of work done in the first four months of 1884 almost equals the total previous work done to Jan. 1, 1884. This was the case at Suez where in a total of 100,000,000 cu. yds. to be moved 66,600,000 cu. yds. were excavated during the last two years, that is to say after the plant had been created and the contractors were provided with tools appropriate to the work on hand. This progress, slow but sure, sacrificing nothing to effect, is in accordance with the resolutions made at the organization of your company.

In the execution of a work like this, almost solely in excavation, the progress forward and final success depends entirely upon machinery and its judicious employment. It may happen in practice that an apparatus designed for one point may do better execution in another, and experience may prove that at other points hand labor is preferable. But while delays have occurred and in places the cube excavated has not met original estimates, from a practical point of view, the work done accords generally with previous calculations.

From a working force of 6,200 men employed in the year past, the force has now expanded to 19,000 men. We can always draw from the Antilles the labor required.

M. de Lesseps concludes his report by saying:

It remains to state upon what elements we rest our confidence in the completion of the canal within the time fixed.

We have remarked before that the work of piercing the American Isthmus consists purely and simply in excavation, in the cube to be removed. We have not, as at Suez, to lead the sweet water of the Nile out into the open desert; to pass a maritime canal through a lake of mud, to cross two mountains of sand; to conduct the salt water into vast depressions and to create a port upon a declivous coast, with protecting jetties and the menace of silting up. These problems were for a long time considered as impossible of solution at Suez. At Panama it is digging, pure and simple; the

problem consists in so organizing the work that the machinery employed will remove a certain amount of material in a certain time.

We took the wise precaution, at starting, of selecting from all the geological data, on the Isthmus, the wors and the most difficult, that which would require the greatest amount of work, and the estimates of execution were founded upon this worst data. We have already, several times, had occasion to call attention to fortunate modifications in our original estimates, and a considerable portion of the Isthmus, originally set down as very hard rock has proved to be ordinary earth.

M. Dingler, the Director General of the works, estimates that of the 143,880,000 cu. yds. to be moved in digging the Canal, 52,320,000 cu. yds., can be raised by the dredge; that is to say, by the most economical and expeditious method.

Including the trenches for the rectification of the Chagres River, 13,080,000 cu. yds., there would remain 104,640,000 cu. yds. to be removed dry. To extract this we have machinery the monthly mean value of which is as follows:

Each large car, counting all loss of time, etc., 294 cu. yds.

Each car of the Decauville system, 130 cu. yds.

Each transporter, 39,240 cu. yds.

Then 4,500 large cars, 4,000 Decauville cars and 20 transporters will give a monthly cube of 2,616,000 cu. yds.

As to the dredges, without counting the four small dredges of 60 horse-power each, the return from each of the forty dredges will give a cube of 654,000 cu. yds. per annum.

This material is calculated to execute the total of the dry excavation in three years and the dredges do their work in two years.

Hence it is shown that if the dry work had only been commenced on the 1st of January, 1885, and the dredging on the 1st of January, 1886, the Canal could be finished on the 1st of January, 1888.

To complete this programme, there is yet required the following plant: 1,500 cars, 28 locomotives, 1 marine dredge, 10 dredges with overfalls, 12 American dredges, 3 hopper barges, 34 lighters, 25 traction engines, 20 excavators, 68 pumps, 50 inclined planes, and 50 groups of 126 lamps each for lighting the works at night. All of this material represents an expenditure of about $7,000,000.

The rest of the material is upon the Isthmus or en route; it consists of 79 excavators, 20 transporters, 256 pumps, 56 hoisting machines, 38 steam cranes, 814 derricks, etc., 122 locomotives, 8,961 cars, 259 miles of railway, 21 dredges, 4 steam-boats, 30 tow-boats, 316 floating machines of different kinds, and 72 traction-engines."

August Showers in San Francisco.

Light showers of rain, an unusual thing for August, fell in this city and vicinity this morning, first about 6 o'clock, again a little before 8, and this afternoon about 1 o'clock more large drops came pattering down. The sprinkle, continued up to noon, did not cause enough moisture in the gauge of the Signal Service on top of the Merchants' Exchange to be measured. Sergt. Gordon asserted, however, that it amounted to close upon .01 inch. This is the first rain that has fallen in August since 1878, when about the same amount was recorded. Back of this date since 1849, the total rainfall in this month has amounted to only .67 inch, and the average fall in that time was .02 inch. August has a better record in this respect than July, for only 35 inch. has fallen in 34 years in that month. From previous years it is seen that rain late in the Summer means usually a less quantity in the Winter months following. This was observed to be the case in 1860 and again in 1865. A slight rain fell also to-day about the bay regions in San José and Redwood City. Yesterday afternoon a sprinkle was noted in Merced. In Berkely it was raining at 5.30 this morning, continuing with only slight intervals of cessation until nearly 9 o'clock. The season s total in this city to date is 32.38 inches.—From the *San Francisco* (Cal.) *Bulletin*, Aug. 4.

TURNOUTS:

Exact Formulæ for their Determination, together with Practical and Accurate Tables for Direct use in the Field.*

BY W. B. PARSONS, JR., C. E., ROADMASTER NEW YORK AND GREENWOOD LAKE DIVISION, ERIE RAILWAY.

(*Continued from page 68.*)

Description of Tables.

[*All tables are computed for a gauge of 4 ft. 8½ in.* 4.7083 ft.]

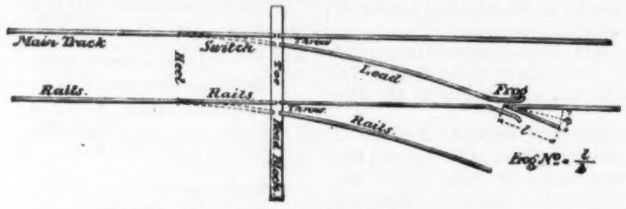
Table No 1, (See ENGINEERING NEWS July 12th) gives all the required data for laying out turnouts, whether single or double, and for any frog-angle. In the first column are given frog numbers increasing by halves from 5 to 13, with their corresponding angles in the second column. In the third column will be found the distance from frog-point to head-block; in the fourth, the length of the moving-rail for 5 in. "throw"; and in the fifth, the total length of "lead" from frog-point to where the turnout curve becomes tangent to the main-track, *i. e.* the "heel" of the switch. These distances are all to be measured on the main-track. Columns 6, 7 and 8 show respectively the lengths of tangents, radii and degrees of curvature of the turnout curves. The next three columes relate to 3—throw switches; the first giving distance from point of crotch frog to head-block, and the second and third show the crotch frog angles and their corresponding members.

The distances which are used directly in actual measurements are given in feet and inches and are printed in heavier faced type so as to be easily found. Dimensions, such as tangent length and radius, needed for reference in future calculations are given in feet and decimals. Although this table is computed for turnouts from straight lines, yet, with the exception of those figures used in columns 6, 7 and 8, all the dimensions will be practically correct for turnouts from curves in ordinary cases.

It must be remembered that in all these tables where distances from frog-points are given it is from the *true* point. As frogs are generally blunt, the difference between the *practical* point and the *true* point must be added in each case.

This table can readily be extended in both directions by noting that there is a constant increment in the values of the following:—Distances from frog-point to head-block, length of moving-rail, total length of lead and crotch frog distance, for each half variation in the frog number. This increment, for frog distance, is 3 ft. 3¾ in. (3.31 ft.); for moving-rail, 1 ft. 4¾ in. (1.40 ft.); for total length of lead, 4 ft. 8½ in. (4.708 ft.); and for crotch, frog distance, 1 ft. 11¼ in. (1.925 ft.)

In order to find the dimensions of turnouts for 3 ft. gauge, divide the above distances by their corresponding increments and multiply them by 2, 1, 3 and 1.12 respectively. This law in general is applicable to change to any other gauge, having found the increments of that gauge to multiply by.



Frog Diagram.—Giving Nomenclature of Parts

Table No. 5.—Bills of Switch-Timbers for Frog No. 5.

18-*in. Centers.*				22½-*in. Centers.*			
PIECE.			LENGTH.	PIECE.			LENGTH.
1	6" × 8" ×	8'	6"	1	6" × 8" ×	8'	7"
1	"	8'	8"	1	"	8'	8"
1	"	8'	9"	1	"	8'	10"
1	"	8'	11"	1	"	9'	0"
1	"	9'	0"	1	"	9'	2"
1	"	9'	2"	1	"	9'	5"
1	"	9'	4"	1	"	9'	7"
1	"	9'	6"	1	"	9'	10"
1	"	9'	8"	1	"	10'	1"
1	"	9'	10"	1	"	10'	4"
1	"	10'	0"	1	"	10'	7"
1	"	10'	3"	1	"	10'	11"
1	"	10'	5"	1	"	11'	2"
1	"	10'	8"	1	"	11'	6"
1	"	10'	11"	1	"	11'	11"
1	"	11'	2"	1	"	12'	3"
1	"	11'	5"	1	"	12'	7"
1	"	11'	8"	1	"	12'	11"
1	"	11'	11"	1	"	13'	4"
1	"	12'	3"	1	"	13'	8"
1	"	12'	6"	1	"	14'	1"
1	"	12'	9"	1	"	14'	5"
1	"	13'	1"	1	"	14'	10"
1	"	13'	5"	1	"	15'	3"
1	"	13'	8"	1	"	15'	7"
1	"	14'	0"	1	"	16'	0"
1	"	14'	4"				
1	"	14'	7"	26 pieces.			304.6 lin. ft.
1	"	14'	11"				=1218 ft. B. M.
1	"	15'	3"				
1	"	15'	6"				
1	"	15'	10"				
32			371.10 l. ft.				
			=1487.7 ft. B.M				

Table No. 6.—Bills of Switch Timbers for Frog No. 6.

18-*in. Centres.*				22½-*in. Centres.*			
PIECE.			LENGTH.	PIECE.			LENGTH.
1	6" × 8" ×	8'	6"	1	6" × 8" ×	8'	6"
1	"	8'	7"	1	"	8'	8"
1	"	8'	8"	1	"	8'	9"
1	"	8'	9"	1	"	8'	11"
1	"	8'	11"	1	"	9'	1"
1	"	9'	0"	1	"	9'	2"
1	"	9'	1"	1	"	9'	4"
1	"	9'	3"	1	"	9'	6"
1	"	9'	4"	1	"	9'	8"
1	"	9'	6"	1	"	9'	11"
1	"	9'	8"	1	"	10'	1"
1	"	9'	10"	1	"	10'	4"
1	"	10'	0"	1	"	10'	6"
1	"	10'	2"	1	"	10'	9"
1	"	10'	4"	1	"	11'	0"
1	"	10'	6"	1	"	11'	3"
1	"	10'	8"	1	"	11'	6"
1	"	10'	10"	1	"	11'	10"
1	"	11'	1"	1	"	12'	1"
1	"	11'	3"	1	"	12'	5"
1	"	11'	6"	1	"	12'	9"
1	"	11'	8"	1	"	13'	0"
1	"	11'	11"	1	"	13'	4"
1	"	12'	2"	1	"	13'	8"
1	"	12'	5"	1	"	14'	0"
1	"	12'	8"	1	"	14'	4"
1	"	12'	11"	1	"	14'	7"
1	"	13'	2"	1	"	14'	11"
1	"	13'	5"	1	"	15'	3"
1	"	13'	8"	1	"	15'	7"
1	"	13'	11"	1	"	15'	10"
1	"	14'	2"				
1	"	14'	5"	31			360.6 lin. ft.
1	"	14'	8"				= 1442 ft. B.M.
1	"	14'	11"				
1	"	15'	2"				
1	"	15'	5"				
1	"	15'	8"				
1	"	15'	11"				
29			433.8 lin. ft.				
			= 1814.7 ft. B.M.				

TO BE CONTINUED.

MR. JACOB ELMER, of Biloxi, Miss., has received a patent for a newly invented system of fascines to be used in the protection of harbors and river banks, the building of roadbeds for railways through swamps and marshes, and like purposes. The fascines consist, not of brushes, but of saplings banded together in a tubular body by iron hoops, with a core of stones in the center to sink and keep them in place, and with cylindrical blocks at the ends to fasten the whole.

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The Industrial Situation.

The past thirty days have developed several new tendencies in the industries deserving of attention. A proposition has been made to shut down all the blast furnaces of the United States for a period of thirty days. The Southern pig iron makers gave their assent, and a majority of the Northern blast furnace owners have signified their willingness to enter into such an arrangement; but it is doubtful whether the plan can be carried out; there are too many difficulties in the way. The larger mills have their own blast furnaces and make the iron as they need it. These, of course, cannot join in such an arrangement. A four-weeks' suspension would keep from 300,000 to 400,000 tons of iron out of the market. At present, stocks are but little in excess of a quarter of a million tons. Founders, mill men, and consumers of pig iron everywhere, are unwilling to purchase more iron than they need for immediate consumption, and prices are consequently weak and declining. The iron trade is in an anolous condition.

Foreign stocks are almost nothing. Stocks in second and third hands are reduced to lower proportions than for years, and prices are lower than they have been for years. The outlook is far from encouraging. The strong companies refuse to permit any accumulation of stocks. The Southern furnace companies, which were supposed to be better able to stand a cutting competition than the Northern, were, it seems, the first to call for a restriction of production.

In the finished iron trade there is less activity than at any time for years. At Pittsburgh, especially, a great deal of complaint is made. In the Ohio Valley several mills are idle. In the interior most of the mills are working but half time. In eastern Pennsylvania very few mills have more than enough orders on hand to last them two or three weeks. Prices for bar iron range from 1.60 to 2c. per lb., according to location of mill. The bridge works are better fixed. Large quantities of plate and structural iron been ordered within sixty days, and it is probable that the mills on plates and shapes will be kept busy well into the winter.

The steel rail mills are short of orders, and even at the reduction to $27.50 to $28 in Pennsylvania mills, buyers are very backward, and are higgling over prices.

Steel nails are threatening to take the place of iron, and several hundred men who have been engaged in making iron nail plate at Wheeling, have been discharged as the nail makers there have arranged to obtain steel nail plate from Pittsburgh.

Several thousand tons of old rails have been sold within a few days, and the market is almost bare of stocks. The sheet mills are busy on Iron for building requirements. The nail mills are generally working full time, and stocks are accumulating, while prices are weakening. Tne entire situation of the Iron trade at present, is creating a good deal of apprehension; but the clouds will pass by in a few weeks, because of the fact that the actual requirements of the country are large. Manufacturers have been pursuing a very conservative course as to production, and buyers have been very cautions, hence, the market has the strong feature, that stocks are very light, and a little improvement in demand will soon be noticed, and this will impart a stimulus to trade, and bring large buyers into market, and trade conditions will at once improve. In coal trade circles an unsatisfactory condition of things exists. The Antharacite Mines have been idle nearly one half of the year so far, and another week's restriction has just been announced for September. The capacity of the anthracite region is now 150,000 tons per day. The manufacturing requirements in the East are less this year than last. Stocks are not permitted to be large, on account of the danger of depressing prices. The bituminous coal trade of middle and western Pennsylvania and the block coal trade of Ohio and Indiana is beginning to improve, in consequence of the arrival of orders for Fall and Winter stocks.

The restriction in textile manufacturing continues, and a good many mills have shut down within a week or two in New England and New York. Restriction is also being enforced in North Carolina, and to a certain extent in Georgia; but trade conditions are rearranging themselves, and it is probable that, when the Fall trade fully opens, the textile manufacturers will find sufficient encouragement to induce them to increase their production to the normal limits.

The situation among the laborers is generally satisfactory, although a few strikes are in progress in different parts of the country. The iron and steel workers, glass workers, and nail makers, are at peace with themselves and their employers. Reductions of wages has taken place in two of the Bessemer mills, and it is probable that reductions will shortly be made in all. It is probable that the coke syndicate will order a further restriction of production, owing to the accumulation of stock, and the declining tendency of prices.

LITERATURE.

Proceedings of the Engineer's Club of Philadelphia. Vol. IV. No. 2.

The contents of this last number includes a short illustrated paper by Col. Wm. Ludlow, upon "Chemical Obstructions in Iron Water Pipes," showing the effect of rust upon 2 in. and 3 in. iron pipes laid for twelve or fourteen years, neither of these pipes had been "dipped" in any preservative compound and the channels for water had been reduced in places to ⅛ in. in diameter. Messrs. Edward Thiange and J. M. Rüdiger submit a paper with diagrams upon "Simple and Compound Railroad Earthwork Formations." The paper is exhaustive and interesting and describes the construction and practical use of diagrams for estimating contents of earthwork, and also the staking out of work and the graphical determination of the distances of haul.

Col. Wm. Ludlow also gives "Observations upon the Crushing Strength of Ice"—made in 1880–81 while considering the construction of an Ice Harbor at Liston's Point on the Delaware River. From experiments made at Frankford Arsenal by the author, the conclusion was arrived at, that the pressure required to crush the clearest and most compact ice was 1,000 lbs. per square inch, and that ordinary ice such as would be found in the Delaware River at the point named would crush under 400 to 450 lbs.; for ordinary clear ice, as from the upper Delaware 700 lbs. per square inch was an average.

Mr. J Godolphin Osborne describes the Pocahontas "Mine Disaster," in especial reference to the methods of procedure for flooding the mine.

Thos. M. Clemann has a paper "On an Economical Form of Bridge Truss," advocating an inverted bow-string with the ends of the tension member or lower chord anchored to the abutment, thus avoiding much of the dead weight now in the upper chord, that member being only proportioned to carry the variable load. He illustrated his theory by diagrams and a model.

The Sanitary Engineer. Vol. IX., December, 1883, to May, 1884.

We are indebted to the publishers of the above most excellent journal for a bound copy of Vol. IX. To review a technical journal is somewhat akin to attempting a similar task upon a dictionary, the field is extended and the subject matter somewhat disconnected. So we can only say that *The Sanitary Engineer* is a model journal of its peculiar class, careful and painstaking in its opinions and displaying great taste in its general make-up. In the better regulation of the many fittings in our households and in public buildings, in the care of the public and private health and the doings of the various Boards of Health in the country, in fact, in all matters pertaining to sanitary affairs, it is an authority, and as such should command a wide circulation.

Transactions and Proceedings, American Society of Civil Engineers. May, 1884.

The paper of this number is "Description of a Combined Triangular and Suspension Bridge Truss and Comparison of its cost with that of Warren, Pratt, Whipple and Howe Trusses, by Edwin Thatcher, with illustrations."

BOOKS RECEIVED.

Première application a Paris en 1883 de l'Assainissement Suivant le Systeme Waring. Par ERNEST PONTSEN, I. E. *Paris*, 1884.

The Principles of Ventilation and Heating and their Practical Application. By JOHN S. BILLINGS, M. D., L. L. D., Surgeon U. S. Army. *New York, Sanitary Engineer, Price*, $3.00.

Testing Machines, their History, Construction and use, by ARTHUR V. ABBOTT, *Reprinted from Van Nostrand's Magazine, No. 74, Van Nostrands Science Series. Price* 50 *cts.*

The Imaginary Metrological System of the Great Pyramid of Gizeh; by F. A. P. BARNARD, L. L. D., S. T. D., Pres. Columbia College. *From the Proceedings of the American Metrological Society. New York.* JOHN WILEY & SONS, *Publishers. Price* $1.00.

Traité Pratique d'Analyses Chemiques et d'Essais Industriels, Méthodes Nouvelles pour le Dosage des Substances Minérales, Minerais, Métaux, Allaoages et Produits d'Art. A l'usage des Ingénieurs, des, Chemistes, des Métallurgistes, etc., Par RAOUL JAGNAUX, *Inginieur—Cheniste, Paris. Octave Doin, Editeur, 8, Place de l'Odeon, 1884. (Price 6 Francs.)*

Stadia Surveying. The Theory of Stadia Measurements accompanied by Table of Horizontal Distances and Differences of Level for the Reduction of Stadia Field Observations. By ARTHUR WINSLOW, Asst. Geologist, 2nd Geological Survey of Penna. Van Nostrand's Science Series No. 77. *Price* 50 *cents.*

A Treatise on Toothed Gearing. Containing Complete Instructions for Designing, Drawing and Constructing Spur Wheels, Bevel Wheel, Lantern Gear, Screw Gear, Worms, etc., and the proper formation of Tooth-profiles. For the use of Machinists, Pattern-makers, Draughtmen, Designers, Scientific Schools, etc. By J. HOWARD CROMWELL, Ph. B. *New York.* JOHN WILEY & SONS, *Publishers, Price*, $2.00.

Cottages, or Hints on Economical Building. Containing 24 Plates of Medium and Low Cost Houses, contributed by different New York Architects. Together with descriptive letter-press giving Practical Suggestions for Cottage Building. Compiled and edited by A. W. BRUNNER, Architect. *To which is added a Chapter on the Water Supply, Drainage Sewerage, Heating and Ventilation, and other Sanitary Questions relating to Country Houses. By* WM. PAUL GERHARD, C. E. WM. T. COMSTOCK, *Publisher, New York. Price*, $1.00.

A PLAN recently introduced into Belgium for preserving wood from decay produced by the atmosphere, water, etc., is to fill the pores with liquid guttapercha, which is said to effectually preserve it from moisture and the action of the sun. The process employed consists in exhausting the air from the pores of the wood, and filling with guttapercha solution. In pouring the solution into the pores, the solid guttapercha is liquified by mixing with paraffine in proportion of about two-thirds of guttapercha to one-third of paraffine; the mixture is then submitted to the action of heat, and the guttapercha becomes sufficiently liquid to be easily introduced into the pores of the wood. The guttapercha liquified by this process hardens in the pores of the wood as soon as it becomes cold.

THE natives of Stonington, Conn., assert that it has never rained there on the 10th of August for 101 years. That is the day they celebrate, and the weather record, they say, has been accurately kept in the borough ever since the first anniversary of the battle of Stonington.

CORRESPONDENCE.

Magnetic Test for Flaws in Iron.

Special Correspondence Engineering News.

MONTGOMERY, ALA., Aug. 8, 1884.

EDITOR ENGINEERING NEWS:—Sometime since in reading a discussion in the Transactions of the American Society of Civil Engineers, which I cannot find now, some member stated that he had heard of the magnetic needle being used in testing iron, but did not know how it was done; and no other member seemed to know as none replied. Talking over the matter with my cousin, Capt. T. G. Williamson, C. E., he told me he had seen it, and as well as he could recollect the test was made first by a Captain or Lieutenant Saxby, R. N. It seems he was charged with testing a very large shaft for a steam vessel. He connected both ends of the shaft with a battery and passed the needle over the surface of the shaft. At one point it vibrated or changed its direction, which of course you know should be at right angles to the current of electricity. He pronounced the shaft unsound, and said if they would break it, and no flaw discovered, he would pay for it. It was broken and a flaw discovered. It seems strange to me that this test has not been tried oftener, as it must be a very delicate, and I should think, a good test.

Hoping this suggestion may be of service to those of the profession who have opportunities of testing iron,

I am very truly yours,

W. G WILLIAMSON,
M. Am. Soc. C. E.

The Cost of Dredging.

Special Correspondence Engineering News.

PORTLAND, ME., Aug. 11, 1884.

EDITOR ENGINEERING NEWS:—In answer to the article of your esteemed correspondent, in No. 6, p. 67, of your journal, I have to say, that allowances for enforced idleness, detentions on account of bad weather, and transportation of plant from one place to another, etc., though well known to me, have purposely not been introduced into the comparison between the English elevator and the American clam-shell dredge, because allowances for those items were *not* mentioned for the English dredge, which was employed on the same work for three years (perhaps longer) without change of location, and no data are given respecting time lost by bad weather.

The 275 working days per year, assumed for that machine, however, will allow—excluding Sundays and probable holidays—only some 30 days for that purpose and repairs.

The comparison was made for cost of maintenance and quantities dredged *per working day* in both cases, and therefore rests on an equal basis.

In reference to handsome and often quite enormous profits, which have been made *quite recently*, though I do not feel called upon to state by whom or where they were made, I will show that this statement is not made at random, and would request your correspondent to examine the following *facts* and judge for himself.

Contract	Number of wokring days.	Average day's work in cubic yd.	Average gross earnings per day.	Daily expense as stated in former article ENG. NEWS, No. 5.	Total net earnings per contract.
I.	192	1401	$238 1/10	$93	$27,872
II.	167	1437	162 25/100	93	16,598
III.	225	384 1/10	162 1/10	93	22,331
IV.	184	474	175 25/100	93	15,158
V.	66	593	189 7/10	93	6,386

The figures in the last column of this table will stand considerable reductions for allowances, claimed by your correspondent as *neglected*, and still, sums would remain, which—for the time in which they are accumulated—could pass, under circumstances, as handsome and perhaps enormous profits, to modest minds at least.

Respectfully Yours,

A. C. BOTH.

NOTE:—The work done in Portland Harbor, mentioned in article on the Both Dredge in ENGINEERING NEWS of August 2, was done with clam-shell dredge of other types, not with the Both bucket.—ED. ENGINEERING NEWS.

THE St. Augustine *Press* says it is a settled fact that the proposed bridge between Tocoi and West Tocoi, over the St. John's River Florida, will be built in the near future.

A NEW copy of Humber's "Water Supply for Cities and Towns," for sale, enquire at office of ENGINEERING NEWS. Price $15.

The Telegraph in France.

The apparatus used at present in France belongs to several different types, the Morse, Hughes, Wheatstone, Meyer and Bandot systems are in use, the two last being the most perfect. In the entire telegraphic system of France there are 7,702 Morse instruments, each capable of transmitting 20 to 30 dispatches, say 400 to 600 words per hour.

The Hughes system is represented by 536 instruments, each sending 40 to 60 dispatches, or 800 to 1,200 words per hour.

The Wheatstone system is used with only 8 instruments, furnishing each 100 dispatches, or about 2,000 words per hour.

The Meyer system permits the sending of four or even six dispatches at one time, and transmits 75 dispatches, or 1,500 words per hour. This apparatus is being used with great success upon the Paris-Caen-Cherbourg line, and by it dispatches can be sent simultaneously to three stations over the same wire.

The Bandot system enables 200 dispatches, or 4,000 words per hour to be sent. This machine transmits and prints six dispatches at a time, surpassing in speed all the other systems. It is in use between Paris and the following cities: Lyons, Marseilles, Bordeaux, Havre, Brest and Lille; and also between Bordeaux and Lyons and Marseilles. Its application promises to become general.—*Moniteur Industriel.*

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page 70.*)

DCLXVII. CHAMBERLAIN, DAK.

Chamberlain, Dakota in lat. 43° 45′ N., long. 99° W., is on the Missouri River at the base of, and on bluffs rising 400 ft. above the river. Settled in May, 1881, it was incorporated a city in 1882. Water-works were built in 1883 and 1884, by the city, after plans of B. B. Colburne, the supply being taken from the river, and pumped by a compound duplex Worthington pump of 10 and 16 in. steam and 7 in. water cylinder and 10 in. stroke, to a reservoir 108 ft. long, 70 ft. wide and 14 ft. deep, excavated in earth and lined with puddle, brick and cement, holding 525,000 gallons at 154 ft. above the main street of the city and 215 ft. above the pump.

Distribution is by 1½ miles of wrought-iron pipe of 5 in. diameter, with 10 fire hydrants and 7 gates.

The population in 1883 was 1,200.

The works have cost $15,000. No further information is given.

DCLXVIII. FRACKVILLE, PA.

Frackville, Schuylkill Co., Pennsylvania in lat. 40° 45′ N., long. 76° 10′ W., is in a mountainous region of which the leading industry is the mining of coal and iron.

Settled in 1861, it was incorporated a borough in 1876. Water-works were built in 1883 by a private company after plans of John Haupt, C. E., taking the supply from Little Mahanoy Creek, which has a drainage area of 5 square miles. The water is pumped from the creek by a Blake Steam pump, lifting 150 ft. to a reservoir 100 ft. square, holding 500,000 gallons, at an average elevation above the town of 50 ft. Distribution is by 2 miles of cast-iron pipe of 4 in. diameter with 4 gates and 40 taps. Service pipes are of wrought-iron and lead. There are no fire hydrants.

The population in 1880 was 1,707 it is now said to be 2,196.

The capital stock of the company is $20,000. F. S. Haupt is President and J. Haupt, Secretary and Treasurer.

DCLXIX. HOOD RIVER, ORE.

Hood River, Wasco Co., Oregon, in lat. 45° 45′ N., long. 121° 30′ W., is on the Columbia River at the mouth of Hood River.

Settled in 1882, it is still unincorporated.

Water-works were built in 1883 by a private company after plans of H. C. Coe, the supply being taken from a spring on a hill 150 ft. above the village and being distributed by ¾ of a mile of pipe of 1 to ½ in. diameter. No further information is given.

The population in 1883 was 100. H. C. Coe, manages the works.

WATER.

TO THE ADVERTISERS IN CROES' STATISTICAL TABLES.—In accordance with our Contract with Advertisers in Croes' Statistical Tables we have mailed one or more copies of "Tables" to every Water-Works office in America of which we could gain any intelligence. We have sent them to every person whom we could associate in any way with Water-Works interests; we have distributed them among the officials of towns which are contemplating a water supply; our advertisers have distributed extra copies where they "would do the most good," and great care has been exercised in not allowing copies to be wasted. We have some copies still on hand to be sent to parties yet to be discovered. If any of the advertisers in the "Tables" know of *a single* Water Works office in America being unsupplied with a copy, or if they know where another copy can be placed to advantage, and will so inform us, we will mail one or more at once *free of cost*. We want *every copy* to be out and at work for our patrons and ourselves, and the sooner it is accomplished the better pleased we will be.

THE town of Ennis, Tex., longs for a system of Water Works.

THE reservoir of the Fairbault, Minn., Water Works, is completed

THE final test of the Water Works at Huron, Dak., has resulted satisfactorily.

THERE are but 178 water meters in use in Lynn, Mass., while the number of water takers is upward of 8,000.

THE St. Paul Water Works force lay daily 200 ft. of 30-in. two ton pipe, 350 of 20-in. ton and a quarter pipe, and 300 of 6-in. 400 pound pipe.

The contract for the Farm Pond Conduit, Boston, has been awarded to Mr. George M. Cushing, of New York, whose bid, it will be remembered, was $68,459.80 against an estimated cost of $89,100.

ABILENE, TEX., August 8.—The negotiations which have been in progress some time between the city government and a Columbus (O.) firm have terminated by the firm agreeing to erect Water Works costing $50,000.

AT a recent meeting of the Minneapolis Water Board the Committee on Extensions reported that they had let the contract for the construction of mains on Highland Avenue and Eleventh Street, from Harmon Place to Hennepin Avenue, to John Gleason & Co., they being the lowest bidders.

BY order of the Water Board of Lynn, Mass., Birch Pond is to be drawn down to allow the workmen to connect the pipe crossing Birch pond with the pipe leading to the pumping station. The water is now flowing through the tunnel into Saugus River, and the city is getting its water from Breed's Pond. The proposition to raise the height of the dam seven feet is now before the Water Board. The present height is about 15 ft.

ROCKFORD, ILL., has made a contract with the Holly Manufacturing Co., of Lockport, N. Y., for a compound Gaskell horizontal pumping engine of 90,000,000 guaranteed duty and daily capacity of 3,000,000 gallons. The price was $13,000, taking in payment an old engine and $12,500 cash. There were 13 bids representing all the prominent makers in the country, and the bids ranged from $18,000 to $6,650.

A DAM to be built in Brazil will be one of the largest in the world. It will be 940 ft. long by 58 ft. high, and two smaller ones will close side depressions. This work will, it is calculated, back the water over 1,500 acres, and retain 14,000,000 cubic meters (49,420,000,000 cubic ft.) of water, sufficient to provide for all the cattle of the regions during three years, and for the irrigation of 5,000 acres of flat bottom land alongside the river bed below.

SPEAKING of an extension of the city water supply the Boston *Journal* says: "The new water basin at Ashland will be completed this fall and water will be let on to kill vegetation that may have accumulated. Next spring the water will be run off and the basin thoroughly cleansed, after which it will be refilled, and form one of the principal sources of supply in an emergency. With the immense storage capacity afforded by this new reservoir there will be no trouble for years as to a scarcity of water.

THE 15-year contract for a water supply for the town of Watertown, Mass., has been signed by the Board of Selectmen as the Representatives of the town and the Watertown Water Supply Company. Contracts for the construction of the work will now be made at once, and a portion of the streets of the town will be piped the present season. As a recognition of the action of the town in paying $6,000 a year for 135 hydrants in the 14 miles of pipe, the company has offered to furnish water free of expense for 15 years for use in the Town House and offices connecting the Public Library; also for two drinking troughs on Main Street, to be erected whenever desired by the Board of Selectmen.

B. H. HULL, C. E. has been engaged by the New Haven Water Co., as engineer upon the repairs to their new reservoir, constructed last year. The masonry and embankment fail to hold the water.

THE WATER SUPPLY OF PARIS.—The *Moniteur Industriel* of July 24, states that the Municipal Council of Paris, acknowledging the danger to public health due to the supply of certain quarters of the city solely from the waters of the Seine, are investigating a new source of more potable water. The promoters of this new project own certain important water privileges near the confluence of the Cure and the Yonne, and offer to furnish the city for 60 years with not less than 150,000 cubic metres of water in 24 hours, at a fixed annuity which will make the cost of a cubic metre about 7 *centimes*. At the expiration of the contract the sources of supply and all the works are to belong to the city.

This arrangement will permit Paris to meet an urgent demand without any great immediate outlay as the rates to consumers will nearly meet the annual rents.

NEWS OF THE WEEK.

Miscellaneous.

THE Denver & New Orleans bridge at Pueblo is almost completed. It will be remembered that this was one of the railroad bridges carried away by the floods.

THE Indianapolis Bridge Company has been awarded a contract for a large and handsome bridge across White river, at Rockford, Jackson county, Indiana. The bridge will be of iron, 420 feet long, with a double roadway.

The Court of Common Council, London, Eng. have at last resolved to build a bridge below the present London Bridge. It is to be a low level bridge with draw, and is to start from the end of Litle Town Hill.

THEIR is a probability that the Goverment will erect an extensive fortification, possibly a chilled iron turret with powerful armament, on the high ground of the South end of Deer Island in Boston Harbor.

M. S. CARTTER & Co., of St. Louis are building a number of bridges on the line of the Palatka and Tampa Bay Railroad in Florida. Upwards of a mile of bridges and trestlework is to be built.

THE Rockport Pier Company of Rockport, Mass. has resolved to build another stone wharf in the harbor. The contract has been awarded to Charles W. Parker, the lowest of four bidders, at $6,400. It is to be 270 feet long, 50 feet wide at the end and 90 at the shore approach. It is to be begun at once, and finished probably by early winter.

THE works of improvement of rivers and harbors of New York and New Jersey, under charge of Colonel G. L. Gillespie, authorized by act of Congress July 5, have all been advertised, and contracts will be awarded about the middle of September, and operations will be begun about the first of October. Nothing will be done toward the deepening of Gedney's Channel across the New York bar until a survey has been made in the channel to ascertain the existing depth of water. The sites of the improvements are the upper Passaic, the lower Passaic, including the Newark Bay, the channel between Staten Island and New Jersey leading to Elizabethport, Raritan River, Raritan Bay, Canarsie and Sheepshead Bay, the aggregate amount appropriated being $300,000 approximately.

THIS is the name of a new system of transportation invented by Prof. Fleeming Jenkin, and recently exhibited at the show of the Royal Agricultural Society at Shrewsbury, England. It is an overhead electric railway designed for transit of moderate weights, at slow speeds, in situations where the question of expense or difficulty of construction precludes the erection of an ordinary line. The speed at which the trains are designed to run is about five miles an hour, and each wagon will carry from 100 to 200 weights. The various vehicles are coupled by rigid connections which serve to push them when the locomotive is backing, and also prevent them overrunning each other on an incline. As the line is flexible it hangs in curves from post to post, and thus one-half of the train is always on a down grade, and the other on an up grade, the two balancing each other and keeping the speed uniform. Of course the general direction of the line may be up or down hill, in which case other means are required to secure regularity of motion. The Telpherage Company, limited, had an experimental line at Weston, Herts, for some time, and has sent one to South America, where it is to be employed in the conveyof minerals.

THE work of raising the hull of the steamer City of Columbus is being pushed rapidly forward by a wrecking party from the Boston Tow Boat Company. The work is done by a gang of divers and bargemen, a well-equipped wrecking lighter, furnished with steam hoisting apparatus, being securely anchored directly over the sunken hull. Work has progressed very methodically, and the hull, from the stern to the smoke stack, has been raised. Work is now progressing on the midship and after section of the ship. When work was first commenced the divers found that the forward part of the steamer had entirely collapsed and this portion was first lifted. The balance of the hull stands as erect and is as complete, save for the washing away of the woodwork, as it was the morning she struck. Her boilers will be the next thing raised, and then her engines and machinery. The iron work of the ship was found to be so strong that resort to blasting was had in order to get the iron in proper shape for handling, and this delicate work is performed by the divers, dynamite cartridges being used.

Railroads and Canals.

THE Wichita and Denver will probably be completed as far as Hutchinson this fall.

AN electric railway running at Brighton, Eng., is a decided success and is to be extended.

DENVER, Col., is agitating the matter of an elevated railway or viaduct over the track in North and East Denver.

SOME ten engines on the Pennsylvania system are now being equipped with an electric locomotive headlight.

THE San Antonio & Arkansas Pass Railroad is a projected Texan road of 146 miles between the places named.

IT is reported that the Canadian Pacific will build a branch to Fort Benton, Montana, next spring.

THE Erlanger system will continue their road from Waskom Station, on the Texas Line, to Tyler, Tex.

THE Chicago and Northwestern now controls 5,643 miles of road, and the Chicago, Milwaukee and St. Paul 4770.

THE Connecticut River Railroad Company has double tracked its line from Springfield to Greenefield.

THE Queen and Crescent route to Cincinnati are now preparing to change the gauge of the entire system.

A NEW bridge on the Baltimore and Ohio over the Susquehanna will be 6,830 ft. long. It will be of iron, and made in Europe.

THE Oregon Railway and Navigation Company's Baker City branch is extended from Meachan, Or., southeast to La Grande, 25 miles.

THE Pike's Peak Railroad will be in operation next year, though only 30 miles long, it is one succession of curves and grades, with no tangent over 300 feet in length.

ENGINEERS of the Gulf, Colorado and Sante Fe have reached Midlothian, where they will immediately begin the location of the Waxahatchie tap.

THE Meigs Elevated Railway for Boston does not seem in a hurry to commence. A model is on exhibition, the estimated cost is $80,000 per mile.

EXCURSION steamers are running from Boston to see the dredge at work on the Cape Cod Canal. This machine is the same in type as the American dredges now in use on the Panama Canal.

IN Poland, schemes for the construction of new railways are occupying the attention of financiers. One new line of 265 versts (about 175 miles) in length is soon to be commenced between Schmerinka and Nowoiseliza.

THE line of the Arizona Central, as surveyed, extends from a point on the Atlantic and Pacific, south through Purwitt, Ari., connecting with the Southern Pacific, 225 miles distant. The estimated cost of the road is $3,000,000.

THE Union Pacific surveyors have about finished the work of laying out the ground for a second track between Omaha and Papillion, and it is expected that it will be laid at an early day. The rails will be steel.

THE work of dredging Lynn Harbor is progressing well. When finished, the harbor will have a channel 200 ft. in width extending to the sea, with an average depth of 10 ft. at low water and 20 ft. at high tide.

MESSRS. HOUGH & GEAR, of Buffalo, have submitted bids to the St. Paul Board of Water Commissioners for the job of constructing the terminal chambers at Sandy Lake.

THE Chesapeake and Nashville Railroad being an assured fact, the half million dollars subscription by Nashville has been secured. The construction of this railroad will be commenced soon, the first labor being done between Nashville and Gallatin.

SUPERIOR, Aug. 2.—The Superior Short Line Railroad Company is pushing the construction of the short line through Superior rapidly. Contrary to the usual plan, the company now intends to put a swing bridge across the Nemadji River.

MAJ. G. D. GILLESPIE, U. S. Engs. advertises dredging to be done in Raritan Bay, Canarsie Bay, Sheepshead Bay, in channel between Staten Island and New Jersey, in Passaic River and in Newark Bay. All bids to be in by Sept. 17 and 18.

PROPOSALS were received this week for bridges as follows: On August 9, for iron bridge, 70 ft. long by 16 ft. wide, across Musconnetkong, at Waterloo, N. J. On August 13, for iron bridge over Salem Creek, Salem, N. J. And on August 14, for rebuilding the Meridian St. Bridge Boston, Mass.

THE Pennsylvania Railroad has advertised for proposals on a new station at Jersey City to replace the one recently burned down. Dimensions 80 x 225. Plans and specifications to be seen at 435 Chestnut St., Philadelphia. Bids opened August 20.

A PROJECT to build a dam across the Mississippi at Meeker Island, just above the Minneapolis, for the purpose of creating a water power, was set on foot in 1855. Nothing has been accomplished, however. Now the interest in the scheme is being revived and steps may be taken towards its completion. It is estimated that a 15 ft. dam would give 20,000 horse power.

AN English engineer, Mr. Rammell, has patented a system of propulsion by impulses from station to station for metropolitan railroads. The London *Times* gives a very perplexing description of the apparatus which it is impossible to unravel. Compressed air is the means by which force is applied.

THE improvement of Pensacola Harbor, Fla., is progressing rapidly. A channel 120 ft. wide and giving a depth of 25 ft. at high water has been dredged out, and the contract for widening it to 300 ft. will soon be given out. The outer bar will also be given a greater depth of water.

PLANS have been prepared for a ship canal across Ireland from Dublin to Galway, a distance of 127 miles. The estimated cost for ships of various sizes is as follows: For ships of 1,500 tons, $40,000,000; for ships of 2,500 tons, $60,000,000; for ships of 5,000 tons and upward, $100,000,000. The plans have been prepared by a London engineer assisted by Capt. Eads.

SHREEVEPORT, LA., Aug. 9.—Capt. F. Y. Dabney, Chief Engineer and Superintendent of the Vicksburg, Shreeveport and Pacific Railroad, was in the city today inspecting the work being done on the depot grounds here. The engineers have reached Greenwood and are surveying the ground for connecting the road from Waskom's Station, Tex., on the Texas Pacific, to Reiser Station, La., on the New Orleans Pacific.

WEST Australia, with 30,766 inhabitants and an area of 1,009,000 square miles, has 92½ miles of railroad, or 1 mile to 333 people. South Australia, which extends entirely across the continent from the south to the north coast, wtih the enormous area of 935,000 square miles, has a population of 310,650, which is 311 per mile of railroad. The expenditure on railroads per inhabitant was £20 12 s. ($103), the average cost per mile of the 945½ miles at the end of 1882 having been £6520 ($32,600). Small as it was, however, the net earnings were but 2.56 per cent. on this capital, and the balance had to be made up by taxation. Several of the roads did not earn their working expenses.

THE Baltimore & Ohio and the Pennsylvania companies are both extending their roads south into West Virginia. The Baltimore & Ohio have a large force of hands grading the extension of their road just south of Uniontown, under Van Dyke & Wilson, and nearly one hundred men are engaged in the vicinity of Cheat river, beginning at the State line and working this way, under contractor Foster. There are several hundred men at work on the portion of the route between Morgantown and Fairmont. The road is being rapidly constructed, and before cold weather a large portion of it will be ready for the ties.

The engineers of the Brooklyn Elevated Railway have completed their final surveys. An officer of the road says their litigation is over, they have 200 men at work, have all the money needed, and think they will be running in February, 1885.

The St. Louis, Hannibal & Keokuk Railroad affairs are progressing in the most satisfactory manner. A construction train is kept constantly at work with a steam shovel, and the track is ballasted as fast as men, money and machinery will do it. Some 2,000 tons of steel rails have been laid. Two large and excellent engines have been added, and a Howe truss bridge is being framed to be erected over Salt River. Many of the long trestle bridges on the road are being filled as rapidly as possible.

San Joaquin & Sierra Nevada (N. G.)—An extension is in progress from the present terminus at Lockford, Cal., eastward to San Andreas, and thence along the Calaveras river to Altaville and the Calaveras Big Trees. Some 15 miles of the grading have been finished. The road is now in operation from Brack Landing, on the Mokelumne river, westward to Lockford, 35 miles.

A very common sense test of the electric railway is to be made in Brussels. One line, that of the Rue de la Loi, is to be equipped with motors, and seperate accounts are to be kept, in order to ascertain definitely the cost of the running as compared with the use of horses. The test is to last for one year, and then, should the result warrant it, electricity will be employed exclusively on the street railways of Brussels.

A line is now being surveyed to run from Buffalo to Windsor and Amherstburgh, keeping as near the lake shore of Erie as practicable. The charters upon which it is being run are the Port Rowan and Lake Shore and the Port Royal and Detroit River. Four parties of engineers have been at work since July 8th last, and two more have been started. Trial lines have already been run over 140 miles of the road, which distance is now being located, and construction will commence before September next

The following gives the condition of the railway field in Greece. There are lines between Athens and the Piræus (5 miles), between Pyrgos and Catacoln (7 miles), and between Volo and Larissa (37 miles). In the course of construction there is a line from Velestino to Calabria (81 miles), and one from Piræus to Aeghion (119 miles), both of which will be open this year. In 1885 it is expected that lines from Aeghion to Patras (24 miles), and from Patras to Pyrgos (62 miles), will be opened; and that in 1886 those from Corinth to Nauplia, Milos (43 miles), and Athens to Laurion (43 miles), will be accomplished. Lines from Calames to Meligala (39 miles), and Piræus to Larissa (212 miles), are under consideration.

The Louisville, New Orleans and Texas, is the name of a company which will control the Tennessee Southern Railroad; the New Orleans, Baton Rouge, Vicksburg and Memphis Railroad; the New Orleans and Mississippi Valley Railroad, and the Memphis and Vicksburg. The 235 miles of track between Vicksburg and New Orleans have been laid and trains are now running. Track is also laid 94 miles north of Vicksburg, and from Memphis south 78 miles, leaving a gap of 48 miles to be completed, which is expected to be done by the 1st or 15th of September.

The right of way for the extension of the Wisconsin Central Railway from Chippewa Falls to St. Paul, has been secured up to the Minnesota line and the work of securing the right of way in that State is about completed. The distance from Chippewa Falls to St. Paul is about 104 miles. About 30 miles of steel track is already laid, and the road-bed is graded for the balance of the track. The road now reaches Hay River, and the work of building a bridge across that stream has been completed. An iron and stone bridge has been constructed across the St. Croix River. Steel rails are being laid at the rate of a mile per day. The road will be ready for traffic this year.

The construction of the Canadian Pacific road through British Columbia, may be numbered among the most difficult feats of railroad engineering. The average cost of construction between Emory and Boston Bar, a distance of 29 miles, is over $80,000 per mile. Twenty miles of this has been hewn out of solid granite and carried through 13 tunnels and over 8 large and 14 small bridges. There are 500 bridges and trestle structures between Kamloops and Port Moody. Seven thousand men are now at work, and it is expected that the road will be handed over to the company in about 18 months.

The plans for the canal across Denmark have been approved by the Emperor, and the enterprise encouraged.

It is rumored that 100 miles of the Atlantic and Pacific, in the Indian Territory, are to be completed before January in order to save the land grant, and an extension to the Western Division is contemplated soon.

The Union Pacific's line to Oregon and the Pacific coast at Portland is rapidly approaching completion. The Oregon Short Line now lacks only 2½ miles of reaching Huntington, Oregon, a distance of 640 miles west from Granger, Wyo., the point at which it branches from the main line of the Union Pacific, and 1,417 miles from Omaha. The Oregon Railway and Navigation Company, which is pushing a line eastward to meet the Oregon Short Line, has laid its track to within 77 miles of Huntington, the meeting place, and grading will be completed by September. The distance from Portland, Oro., to Huntington is about 410 miles, making the total distance from Omaha to Portland by this route 1,827 miles, from Chicago to Portland 2,319—which is almost exactly the distance from Chicago to the same point via St. Paul and the Northern Pacific.

A company has been recently organized to build the Iowa and Dakota Railroad. It is to start near Sioux Falls and runs to Bismarck, ramifying the country with numerous branches and feeders. The Huron (Dak.) *Times* says of it: "The estimated length of said railroad will be about 600 miles, and it will run through the following counties; Minnehaha, Lake, Miner, Sanborn, Jerauld, Buffalo, Hand, Hyde, Huges, Sully, Walworth, Campbell, Emmons Burleigh, Pyatt, Delano, Scoby, Mandan, Sterling, Lawrence and Butte Dak. The capital stock of said company shall be $1,000,000, and shall be divided into 10,000 shares of $100 each. The names and residences of the Directors who shall manage the affairs of the company for the first years, or until their successors are elected, are: Fred T. Evans, Sioux City, Io.; Bartlett Tripp, Yankton, Dak.; R. F. Woolfolk, Bismarck, Dak.; Chas. B. Walker, Pierre, Dak.; C. A. Clark, Oswego, N. Y.; E. P. Caldwell, Huron, Dak.

The last completed section of the London Underground Railway, from the Mansion House to the tower, a distance of about three-quarters of a mile, has been built within the last twenty months, and runs "beneath residences, warehouses and roadways, and in all the difficult labors of underpinning, propping and building there has not been a single accident." Enormous warehouses, containing iron safes and strong boxes, have been tunneled under without disturbing their contents, and the statue of King William, which, with its pedestal, weighs 179 tons, has been underpinned and rests on the arch of the tunnel. Large trees have been undermined and underpinned without removal or injury. The result is that there is a substantial roadway on which the heaviest trains can run at high speed.

The branch road running from Palouse, a station on the Northern Pacific 1,623 miles west of St. Paul, to Colfax, Washington Territory a distance of 90 miles, and operated by the Northern Pacific, was closed to business in March on account of extensive washouts, expense of operating, and difficulty of keeping the line open at that season of the year. It has been recently reopened.

This railroad crossing of the Tehachipi pass, Cal., is a feat of extraordinary character in engineering that reflects credit upon every man concerned in its accomplishment. At first glance the mountain seems a formidable and almost insurmountable barrier. In the distance of seven miles it rises 3,000 ft. The intricacies of approach, through hundreds of water washed arroyos, are utterly confusing at first sight, and it is said that four or five locations were examined minutely. It was necessary to make the line 25 miles long in order to overcome the height, even with an equated grade of 116 ft. to the mile. In the locations the road at one point is made to describe a spiral, so that it crosses over itself at a height of 97 ft. above the lower tunnel, and that, too, on such a well-computed gradient that the passenger is readily assured that no undue strain is being exerted by the two engines. After the spiral of the Tehachipi had become somewhat known abroad the engineer from the St. Gothard came to California especially to study the pass of the Tehachipi, and we all know that upon his return he relocated the approaches from both sides, and introduced half a dozen spirals in the solid rock, because he was other-wise handbound by the contracted canon. Since then we occasionally read in foreign journals that the Americans have copied the St. Gothard solution, and I have no doubt the young engineers of Europe will grow up in that belief.

Army and Navy Notes.

The new arm for the Swedish field artillery is an 8.4-centimeter steel breechloader by Krupp, firing a shell weighing 6.7 kilogrammes (of which 0.24 kilogrammes is explosive charge) with a charge of powder of 1.5 kilogrammes, at an initial velocity of 470 meters. The shrapnel and the case-shot are almost as heavy, the former containing 135, the latter 192 balls. The gun barrel weighs 458 kilogrammes. Each battery consists of six guns, eight ammunition and five baggage wagons, carrying 888 projectiles, that is 148 charges per gun, of which fifteen shells and shrapnels and two case-shot are with the gun, and the rest in the ammunition wagons. For arming siege batteries, 12-centimeter guns and 15.5-centimeter howitzers have been experimentally introduced. Of the former army, twelve of cast steel have been supplied by Krupp, the shell of which, weighing 16.8 kilogrammes, has an initial velocity of 475 meters. Other twenty-five guns have been manufactured in Sweden of cast-iron with steel hoops. A 12-centimeter gun and a 15.5-centimeter howitzer have been made of Martin steel at the Bofors Works. Krupp has also supplied eight 15.5-centimeter steel howitzers, and another one of cast-iron with steel hoops has been manufactured at home.

The Special Ordnance Board, to investigate, decide upon and recommend the character, power and number of guns required for our sea coast and lake defence, held their first meeting in New York on August 11. The committee is as follows: Colonel T. G. Baylor, President Ordnance Department; General J. C. Duane, of the Engineers; Major George W. McKee, Ordnance; Major William R. King, Engineers; Captain Edward Maguire, Engineers; Captain Charles Shaler, of the Ordnance Department. The head of this committee of experts, Colonel Baylor, was a member of the Ordnance Committee which, on the part of this Government last year visited Woolwich, Cruso, the Russian gun works near St. Petersburg, etc., Colonel King, of this board, has an international reputation as an authority on the great engineering of modern warfare; he is the author of a work on the counterpoise gun carriage, he has invented a gun carriage himself, he has compiled for the Government an elaborate work on "Experimental and Theoretical Investigations Relative to Defensive Armor, and as far back as 1866 he wrote an exhaustive work on torpedoes, in which he points out the notable fact that Fulton of steamboat fame, was one of the first men who ever used the torpedo and gave it its name after the electrical fish. Not to go further into details, the rest of the Board is regarded as of great strength. Congress, at the last session, appropriated only $175,000 for the repair and preservation of existing defences, and this work is in progress in accordance with the limited appropriation.

PROPOSALS.

Proposals for Furnishing Cast-Iron Water Pipes and Special Castings.

Office of the Engineer Commissioner, Washington, D. C., Aug. 6, 1884.

BY direction of the Board of Commissioners, sealed proposals will be received at this office until 12 o'clock noon, on Wednesday, **August 20, 1884**, for furnishing 945 tons, more or less, of cast-iron water pipes and special castings for the same.

For specifications, blanks, on which bids must be made, and all other information, apply at this office.

G. J. LYDECKER,
Major of Engineers, U. S. A.,
6—2t. Engineer Commissioner, D. C.

Improving Cape Fear River below Wilmington, N. C.

PROPOSALS FOR DREDGING.

U. S. Engineer Office, 70 Saratoga Street, Baltimore, Md., July 24, 1884.

PROPOSALS for Dredging in Cape Fear River, N. C., will be received until eleven o'clock A.M., August 28, 1884, and opened immediately thereafter.

Blank forms, and specifications can be had upon application to this office.

WM. P. CRAIGHILL, Lt.-Col. of Eng'rs, U. S. Army.
5—4t

Improving Cape Fear River below Wilmington, N. C.

Proposals for Furnishing Stone.

U. S. Engineer Office, 70 Saratoga Street, Baltimore, Md., July 24, 1884.

PROPOSALS for furnishing 30,000 tons of Stone for the improvement of the Cape Fear River, North Carolina, will be received until noon August 28, 1884, and opened immediately thereafter.

Blank forms and specifications, etc., can be had upon application to this office, or to the resident Engineer, Mr. Henry Bacon, at Wilmington, N. C.

WM. P. CRAIGHILL, Lt.-Col. of Eng'rs, U. S. Army.
5—4t.